2011

Examining firefighter decision making process and choice in virtual reality

Shawn T. Bayouth
Iowa State University

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by

Shawn T. Bayouth

A dissertation submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Industrial and Agricultural Technology

Program of Study Committee:
Nir Keren, Major Professor
Steven Freeman
Charles Schwab
Mack Shelley
Bethany Weber

Iowa State University

Ames, Iowa

2011

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Acknowledgments

First off, I wish to offer my humblest appreciation to my major professor, Dr. Nir Keren for his constant assistance with this research and his relentless encouragement. He tolerated my idiosyncrasies and bouts of physiological threat-related stress with the utmost professionalism. Next, I would like to thank each of my committee members, Professors Steven Freeman, Charles Schwab, Mack Shelley, and Bethany Weber for all believing in the value of this work. Their help and guidance helped make this a more robust project.

I offer my most sincere appreciation to all the members of the Iowa Fire Service that assisted in this research, including the members of the Ames, Altoona, Clive, Cedar Falls, Des Moines, Indianola, Urbandale, and West Des Moines Fire Departments that took part as voluntary participants in these experiments. I would like to express my sincere gratitude to: Randy Novak, Bureau Chief of the Iowa Fire Service Training Bureau, and Ray Reynolds, Fire Marshal for the State of Iowa who both supported this project; and the experienced fire commanders that assisted with the Focus Group for this project, Chiefs Jerry Holt, Scott Lyon, Rick Roe, Jerry Whetstone, and Captain Rick Schmidt, whose time and commitment to improving this research helped produce more immersive and realistic firefighting scenarios.

I would like to especially thank my supervisor, Clint Petersen, Chief of the Ames Fire Department. I could not have completed this research without his support and backing, and I am extremely fortunate to have had such an accommodating boss during this process. A special thank you goes to each of the three shift commanders at the Ames Fire Department, Scott Siberski, Doug Allen, and Richard Higgins. They afforded me the opportunity to utilize their on-duty staffing of firefighters over the course of a year, to help with this research.

I also wish to acknowledge the assistance of Robert Tegeler, who spent many hours tutoring me in statistics, Kevin Godby, who helped keep the experiments in C6 running, and Sue Weiss, who worked tirelessly to edit this paper out of the goodness of her heart.

Last, but certainly not least, I wish to offer my most heartfelt gratitude to the three members of my immediate family. My loving wife, Jackie wholeheartedly supported me through this long and arduous process, while my son, Booker and daughter, Jessica willingly tolerated my long hours at the computer.

Abstract

Firefighting is an inherently dangerous occupation, with over 100 fatalities and 85,000 injuries in the United States annually (National Fallen Firefighter Foundation, 2005). Though poor decision making may contribute to this high prevalence, surprisingly few studies exist of how emergency responders make decisions. The objective of this study was to utilize the virtual reality environment to identify relationships among firefighter experience, decision-making processes, and acute stress. Broadly, the research questions asked what were the effects of tradeoff values, time pressure, and experience on decision-making characteristics in firefighters; as well as, what were the associations of physiological responses to stress with firefighter decision making? The rationale for this research was that, once decision-making processes by firefighters are better understood, and the relationships among decision-making quality, stress, and firefighting experience are identified, decision-making quality may be enhanced. Interventions could lead to the acceleration of the development of expertise in novices.

Utilizing the highest-resolution computerized virtual reality system in the world on the campus of Iowa State University, participants were exposed to realistic scenarios varying in the stressors of time pressure and tradeoff values. Decision-making processes and final decision choice were assessed in real-time, while heart rate and blood pressure were used to characterize participants' stress state. A total of 62 career firefighters from fire departments throughout central Iowa participated in this study.

Several important findings in this study included the identification of two previously unclassified decision strategies: diminished expectations (DE) and poliheuristic to diminished expectations (POLI2DE). Other findings showed that decision tasks under high tradeoff resulted in significantly less time, required the processing of less information, and were significantly more alternative-based in the search review process. Novices took less time to reach a decision and utilized dimension-based information search patterns more frequently. When time pressure was high, the time to decision decreased significantly and may have been perceived less as a challenge-related task, than under low time pressure. Between 48 - 55% of participants utilized recognition primed decision-making strategy while

under time pressure. Lastly, novices seemed to best recognize the scenario, in that none misidentified the scenario under both low and high time pressure.

CHAPTER 1: EXAMINING FIREFIGHTER DECISION PROCESS AND CHOICE IN VIRTUAL REALITY

Introduction

People make frequent decisions throughout their day-to-day routine (e.g., what to eat, what to wear, which route to take to work), and usually these decisions possess relatively little in the way of consequences. However, there are certain occupations that require much more of people, in the way of decision making (e.g., air traffic controllers, military commanders, race car drivers). Poor decision making in these occupations can have both drastic and dramatic results. Firefighting could be considered one of those occupations, when one reflects how "the fire service continues to make life-and-death decisions every day throughout this country at fires and emergencies" (Dunn, 2008, p. 1). Regarded by some to hold "one of the most dangerous civilian occupations" (Fiedler, 1992, p. 5), firefighters often find themselves on the edge of harm or death, where "loss of life is always a possibility" (Vaughan, 1997, p. 1; see also Department of Agriculture & Forest Service, 2005).

Though the total number of annual structure fires in the United States continues to decline (Foley, 2003) and steps have been taken to dramatically increase safety, the fire service has been unsuccessful in eliminating the hundreds of firefighter fatalities occurring every decade on the fire ground (term used for the area of firefighting activity; Fahy, LeBlanc, & Molis, 2009). Even with significant safety improvements in equipment, clothing, and protocol—recognized and supported by fire personnel—firefighter death and injury statistics continue to remain unchanged (Paulson, 2008). Emphasizing the critical concern over fire ground firefighter injuries and fatalities, researchers from both the National Institute of Standards and Technology (1998) and the National Fallen Firefighters Foundation (2005) have suggested that firefighters can keep themselves out of harm's way by making good decisions. In this high risk environment, the optimal fire ground decisions so vital to successful front line fire suppression can create what Useem, Cook, and Sutton (2005) described as a "decision making burden on fire leaders" (p. 467).

Vincent Dunn (2008), a 42-year firefighting veteran and retired chief of the Fire Department of New York, writes:

> The fire ground commander responding with the first alarm is the person who makes the most life-and-death decisions. The life-and-death decisions made in the first few minutes of the fire are the most important. These decisions lay the groundwork for the entire firefighting operation. (p. 3)

Incident commanders—a position which could be filled by any level of firefighter—are typically more experienced firefighters that take charge of the incident when arriving at the scene. The role of an incident commander is often assumed by the firefighter or fire officer sitting in the front passenger seat of the first-arriving apparatus. Whether that individual retains command or passes it off to a more senior officer is dictated by departmental protocol. Thus, a firefighter may perform as an incident commander, and an incident commander is always considered a firefighter. Regardless, incident commanders often shoulder the additional burden of knowing that the crucial decisions they initially make could quickly resolve or exacerbate a situation. Decisions made by incident commanders impact the fate of many others. Incident commanders are charged with weighing the risk and benefit of every operational decision, managing resources, and looked to for decision-making guidance and direction by the firefighters inside burning buildings. Because of the "decision making burden on fire leaders….optimal leadership decisions are no less vital for successfully suppressing a fire" (Useem, et al., 2005, pp. 462-476). For those who report to the incident commander and are risking their lives fighting a fire, it's important that they have confidence that the firefighter outside guiding them (i.e., incident commander) is making the right decisions (Observer, 2008).

The Challenge

To address "the human consequences of suboptimal decisions by fire leaders" (Useem, et al., 2005, p. 462), it's crucial to understand how and why firefighters, specifically incident commanders, make their decisions (Observer, 2008). Current efforts to improve decision making, such as courses provided by the fire service (FEMA, 2009) and the latest work in decision-making simulators such as Flame-Sim (2010), are prescriptive in nature, and do not address the root cause of poor decisions. Consider the following:

> In September 1999, a 26-year-old mother and her four young children moved into one of the three converted apartments of a 130-year-old, two-story home in the small Mississippi river town of Keokuk, Iowa. Just three days before the 1999 Christmas holiday, members of the Keokuk (IA) Fire Department were dispatched to a fire at this residence. Still asleep at 8:30am, the mom was awakened by her 4-year-old son screaming "FIRE!" Proceeding to the hallway where she was greeted by pitch-black smoke, mom and her 4-year- old eventually escaped from the house with the help of neighbors.
>
> After firefighters arrived on scene, they encounter the mother with 4-year-old in hand, screaming, "My babies are inside!" Deviating from normal operations, the assistant chief entered the building alone (e.g., time pressure decision). The fire chief, arriving a few minutes later, ordered the two apparatus operators into the building to assist the assistant chief with the search for the children. Shortly thereafter, a firefighter passed a 22-month-old male infant out the front door of the apartment to a police officer, who began CPR. The officer and the infant were then transported via police car to the hospital, just six blocks west of the scene. A second child, an unresponsive 22-month-old female twin of the other child, was then passed out the door to the fire chief. It was at that point, the fire chief was faced with one of the most critical decisions of his 24-year fire service career; evaluating the value of the life of a child (loss) and his potential to revive the infant (gain), versus the inherent tradeoff attribute: leaving the scene with no incident commander to provide much-needed leadership and expertise in command decisions. One can only image the internal turmoil this decision event created, as the chief surveyed the scene, considered the alternatives, and weighing the likely consequences of choosing between each alternative until finally making his selection.
>
> With no EMS units yet on the scene, the chief weighed the factors, and possibly considering the loss of a child unacceptable (e.g., non-compensatory

decision), chose to take the infant to the hospital in another police car, with a police captain driving. The fire chief conducted CPR on the infant during the one-minute ride to the hospital emergency room. He handed the infant over to the emergency room staff and quickly returned to the fire scene. It was during the time of the fire chief's absence that two firefighters re-entered the structure to assist the assistant chief in the search for the 7-year-old daughter. However, before the chief's return, all three were caught in a deadly flashover—a phenomenon that occurs when a fire causes everything in a room to become so hot that a flammable gas is produced, instantly igniting and producing temperatures up to 1,500 °F—leaving the Keokuk Fire Department with its first line-of-duty deaths in its 120-year history.

This tragic incident the lives of three Keokuk firefighters and three children (the 7-year-old died in the flashover and the twin died at the hospital), traumatized the Fire Department and community of 13,000 people (Goodrich, 2004, National Fire Protection Agency, 2000; National Institute of Occupational Safety and Health, April 1, 2001). Not to belabor the point, but the emotional toll taken on all involved is dreadfully apparent, when **s**everal years later Keokuk Fire Chief Mark Wessel was quoted as saying: "I relive the day in my mind, every day. I will never forget the horror for the families, the firefighters, the community, and myself. All I have left are opportunities to share the experience in hopes someone, somewhere, will be safer" (Goodrich, 2004, para. 1). Researchers have recognized that command and control decision making, like that experienced by Chief Wessel, has received little detailed and systematic study (Brehmer, 2000) and though several theories have been proposed to explain how these decisions are made, they have not been tested experimentally under realistic conditions.

Significant research on fire ground decision making was conducted by Klein (1993). In his work, Klein utilized verbal protocol to analyze and identify decision strategy. However, Ericcson and Simon (1980), Nisbett and Wilson (1977), and Todd and Benbasat (1987) provided empirical evidences that "thinking aloud – if carried out retrospectively rather than concurrently – often yields unreliable data on decision processes, due to memory distortion, interpretation, and an inability to recall facts, which were not encoded in long-term memory" (Riedl, Brandstatter, & Roithmayr, 2008, p. 796). Thus, due to the lack of decision-capturing technology, it is impossible to evaluate firefighters' decision making, in real-time, under naturalistic conditions.

Recent technological developments allow the utilization of human-computer interactions via virtual reality technology in conjunction with decision-tracing technology to examine firefighters' decision making through simulations. These technological developments provide naturalistic-like settings while preserving the quality of a controlled laboratory setting and a safe environment. This work presents the process and the results of conducting decision making under stress experiments with firefighters in virtual reality. More specifically, the experiments address difficult tradeoff levels and time pressure, well-recognized stressors among firefighters.

Organization of Dissertation

Chapter one is the general introduction which outlines the basic ideas behind the research and summarizes the goals and objectives. Chapter two serves as the literature review of research used as a basis for and justification of the dissertation research. Chapter three is a detailed description of the subjects and a justification for the methodology of the dissertation which provides a rationale for the research design used. Chapter four is a description of the research questions and hypotheses for this research. Chapter five is comprised of results from the data, including both the significant and non-significant research findings. Chapter six is a more in-depth discussion of the relationship between these findings and the current literature. Chapter seven is a summary of the dissertation, the logical recommendations flowing from the research, and the noted study limitations.

CHAPTER 2: LITERATURE REVIEW

Classic theories of choice stress decision making as a rational choice process. In its most basic form, decision making leads to the selection of a course of action, typically consisting of a choice among two or more alternatives. Payne, Bettman, and Johnson (1993) describe typical decision problems using three basic components: (1) alternatives available to the decision maker; (2) events or contingencies that relate to the outcomes and their associated probabilities; and (3) the values associated with the outcomes. Studies have found that rational and classical decision theories are not good descriptions of how decisions are actually made in everyday choices (Kahneman & Tversky, 1979) and since the early-mid 20th century have emphasized how these theories fail to recognize formulation stages of decisions (Dillon, 1998; March & Olsen, 1986). Although extensive research has been done into descriptive theories of choice, much of this research has been done using abstract decisions that bear little resemblance to the naturalistic decisions actually encountered by decision makers. The tension between (1) the way decision makers *should* make decisions, (2) the way decision makers *can and should* make decisions, and (3) the need to understand *how* decision makers *actually make* decisions (Dillon, 1998) led to the development of three major streams of decision-making models of judgment and choice: normative, prescriptive, and descriptive.

Decision Theories

Normative

While there are many processes involved in decision making (Bechara & Damasio, 2000), the *normative* school of decision making emphasizes logic and stresses decision making as a rational choice process. It attempts to describe how fully-informed, logical decision makers would behave, assuming individuals will act rationally in trying to find the best solution to optimize outcome. The normative analytical method of choice says that decision makers identify a set of alternatives and a set of decision criteria, assign the criteria weights, analyze the alternatives according to the set of criteria, calculate values for the criteria of each alternative, and eventually select an alternative with the most favorable score as a course of action. In theory, the highest-valued option will always provide the most optimal solution; but, in reality the environment is constantly changing and information can quickly become outdated.

Normative theory has been shown to work well for situations that are not time critical and are amenable to numeric analysis (Azuma, Daily, & Furmanski, 2006). However, researchers began to realize that this “purely analytic model has no dynamic component, preventing evolution over time” (Azuma, et al., 2006, p. 5), and in the late 1970s to the early 1980s a growing body of literature attests to the inadequacy of rational choice models as descriptions of decision makers’ actual decision method (Einhor & Hogarth, 1981; Kahneman & Tversky, 1979; Klein, N., 1983). Even when presented with simple tasks, people have been shown to behave in ways not consistent with self-evident rules (often their own rules) leading to violations of optimality (Kahneman, Slovic, & Tversky, 1982). Lack of time can hamper the ability to conduct an accurate analysis, rendering this theory unsuccessful in explaining real-world decision making. This is specifically the case in situations marked by time pressure, uncertainty, vague goals, high stakes, team and organizational constraints, changing conditions, and varying amounts of experience.

Prescriptive

The practical application of this *prescriptive* school of decision making is aimed at finding tools, methodologies, and software to help people make better decisions. The most systematic and comprehensive software tools developed in this way are called decision support systems (DSS). Decision support systems include interactive systems that allow one to input problem information which it uses to formulate a solution based on complex algorithms. Woods and Roth (1988) refer to the tools available for expert knowledge in decision making as “cognitive prostheses.” While Bell, Raiffa, and Tversky (1988) suggest that people greatly benefit from decision aids; the problem is that people tend to mistrust DSS, or can’t use it for novel problems, leading many to judge that “prescriptions which are optimal in some formal sense but which cannot be implemented are worthless” (Lipshitz, Klein, Orasanu, & Salas, 2001, p. 335).

Descriptive

Attempts to determine how people *actually* make decisions in day-to-day situations led to a school called *descriptive* models of decision making. Descriptive decision models attempt to describe how decision makers make decisions in real situations, and assume humans do not always act rationally in decision making (assumptions behind the normative models are violated). Research suggests that individual decision-making strategies vary with the number of alternatives considered (Tversky, 1972), and a growing body of literature attests to the inadequacy of rational choice models as descriptions of decision makers' actual decision method (Einhor & Hogarth, 1981; Kahneman & Tversky, 1979; Klein N., 1983). Lack of time can hamper the ability to conduct an accurate analysis, rendering this theory of decision making unsuccessful in explaining real-world decision making. This is specifically the case in situations marked by time pressure, uncertainty, vague goals, high stakes, team and organizational constraints, changing conditions, and varying amounts of experience.

Naturalistic

Since 1989 a new branch of decision-making school has developed to study how people really make decisions in chaotic, uncertain, rapidly changing environments (Klein, Orasanu, & Calderwood, 1993). Naturalistic decision making (NDM), which embodies descriptive theory, is distinguished in terms of the decision maker. Zsambok (1997) suggests that "NDM is the way people use their experience to make decisions in field settings" (p. 4). NDM focuses on those who rely heavily on their expertise, and typically tries to "describe the cognitive process of proficient decision makers" (Lipshitz, et al., 2001, p. 334). The definition of NDM, proposed by Orasanu and Connelly (1993), emphasized the following common characteristics of naturalistic decision settings: ill-structured problems, uncertain, dynamic environments, shifting, ill-defined, or competing goals, multiple event-feedback loops, time pressure, high stakes, and multiple players. As difficult as these complexities were to replicate in the laboratory, they still needed to be studied and understood (Lipshitz, et al., 2001). Thus, NDM researchers set out to examine decision making in natural settings instead of the laboratory, with the goal of studying people performing tasks under conditions typical for the workplace (Phillips, Klein, & Sieck, 2004).

Decision Rules

Holistic

Decision rules can be broken into three first-level categories, holistic, wholistic, and heuristics, based on the amount of information processed by a decision maker (Sage, 1990). *Holistic* decision rules attempt to consider all the aspects in evaluating choices by separating the decision into choice components. It is possible to define and categorize many decision rules as holistic; however a few of the more common theories follow.

Expected Utility Theory (EUT). This method of formalized reasoning suggests that the decision maker utilizes a rational process and follows set rules of behavior with well-defined goals and objectives that lead to satisfaction. The rational person makes a consistent choice of alternative actions to maximize their expected utility. EUT states that the decision maker chooses between risky or uncertain prospects by comparing their expected utility values, i.e., the weighted sums obtained by adding the product of the utility values of outcomes and their respective probabilities (Mongin, 1997). It has been suggested that use of expected utility decision rule does not function well in most cases, and may cause the decision maker to “employ such poor heuristics as to result in inferior choice making” (Sage, 1990, p. 235)

Multiattribute Utility (MAUT). This choice strategy proposes that a decision maker identifies a set of alternatives and a set of decision dimensions, assigns a weight to each of the dimensions, calculates the utility of each alternative on each dimension, and finally selects the alternative with the highest overall utility. Thus, it is suggested that for the typical decision-making task, the decision maker considers a set of alternatives, based on the strategic evaluation of a set of dimensions that ultimately leads to a final choice. Beattie and Barlas (2001) have found MAUT to be the “most pervasive model of riskless decision making” (p. 25).

Subjective Expected Utility (SEU). First suggested by Savage (1954) several decades ago, SEU suggests that when faced with a decision, a rational person's choice would depend on which subjective utility is higher. In SEU, individuality is paramount; people make different decisions based on different beliefs about the probabilities of different outcomes.

Wholistic

Under *wholistic* decision rules, the process of decision making is based on the use of previous experience. When a selection is made, it is founded on the total utility without consideration of the individual aspects and attributes of each alternative. Wholistic judgment process may include the rigid following of standard operating procedures, the use of intuition, and reasoning by analogy (Sage, 1990).

Heuristics

Because normative models of classical decision theory have concentrated on powerful techniques for selecting the best option, a challenge arises when the problem takes effort to evaluate a large set of options and requires more time than what's available. *Heuristics* is a method individuals often employ to reduce the time and cognitive effort necessary to make a choice. By implementing a simplifying strategy or rule of thumb heuristic, the reduction in cognitive load may facilitate more rapid and less burdensome decision making. By limiting the number of hypotheses generated, allowing decision makers to only consider a small subset of possibilities, heuristics approximate the results of more complex optimizing models. This has caused some to characterize the use of heuristics as a relatively weak method more representative of novice-like problem solving (Langley, Simon, Bradshaw, & Zytkow, 1987). Payne, et al. (1993) suggest that "heuristic strategies can be highly accurate in some environments, but no single heuristic does well across all contexts" (p. 131). Some examples of the more common choice heuristics include:

Anchoring and adjustment. This heuristic helps to explain how the initial values influence the way people intuitively assess probabilities. According to the anchoring and adjustment heuristic, people start with an implicitly suggested reference point (the "anchor") and make adjustments to it to reach their estimate. (Tversky & Kahneman, 1974).

Availability heuristic. This heuristic bases the probability of an event occurring on whether it's readily available in memory. Decision makers may estimate the frequency of an event by judging the ease with which they can recall similar instances (e.g., risk of an airplane crash). This heuristic is problematic because the rate at which something comes to mind may not have any relation to its frequency (Tversky & Kahneman, 1973).

Elimination by aspect (EBA). EBA, considered both a heuristic and decision strategy, is followed by decision makers during a process of sequential choice. At each stage in the decision process, an aspect is selected (with probability proportional to its weight), and all the alternatives that do not include the selected aspect are eliminated. The process continues until all alternatives but one are eliminated (Tversky, 1972). Based on Tversky's research, Laurent (2006) proposes the following procedural algorithm to define EBA:

> (a) the common characteristics of the considered choice set are eliminated, as any discriminating choice cannot be based on them;
> (b) a characteristic is randomly selected and all the options not having this characteristic are eliminated. The higher the utility of a characteristic is, the larger the probability of selecting this characteristic is;
> (c) if remaining options still have specific characteristics, one turns over at the first stage. In the contrary, if the residual choices have the same characteristics, the procedure ends. If only one option remains, it is selected. In the contrary, all remaining options have the same probability to be selected (p. 3).

Payne and Bettman (2001) showed that this heuristic is efficient within the "adaptive toolbox", because it carries out a good balance between the cognitive cost and the quality of decision.

Recognition heuristic. The recognition heuristic exploits the "basic psychological capacity for recognition in order to make inferences about unknown quantities in the world" (Gigerenzer & Goldstein, 2011, p. 100). When utilizing the recognition heuristic, inferences are made about criteria that are not directly accessible to the decision maker. Thus, if one of two objects is recognized and the other is not, the inference is that the recognized object has the higher value or utility. Though much work has been done to establish this heuristic as a viable description of how people make inferences, more work is needed to fully integrate research into the mainstream (Ayton, Onkal, & McReynolds, 2011; Gaissmaier & Marewski, 2011; Gigerenzer & Goldstein, 2011; Glockner & Broder, 2011; Hoffrage, 2011). It is important to note that at this stage, significant controversy exists in the current literature on the recognition heuristics and its theoretical description (Marewski, Pohl, & Vitouch, 2011; Tomlinson, Marewski, & Dougherty, 2011).

Decision Strategies

Payne et al. (1993) define decision strategy as a "sequence of mental and effector (actions of the environment) operations used to transform an initial state of knowledge into a final goal state of knowledge where the decision maker views the particular decision problem as solved" (p. 9). Similarly, Reidl et al. (2008) define decision strategy as a sequence of operations used to "transform an initial stage of knowledge in which the decision maker feels that the decision problem is solved" (p. 797). The following includes brief descriptions of a few of the more common types of decision strategies.

Elimination by Aspects. For this strategy, attributes are assumed to have varying utility. Upon review of the decision maker's perceived most important attribute, options that do not meet the cutoff value (cutoff values are often termed threshold values or aspirations) are eliminated. This process is repeated for the second most important attribute, and continues until a single option remains (Tversky, 1972).

Lexicographic. This rule prescribes alternative choice, based on a thorough review of the most important attribute. If more than one option has the best value, the decision will be based on the attribute next in order of importance and so on (Fishburn, 1974).

Majority of Conforming Dimensions. This process involves comparison of attributes under paired alternatives. The alternative with the higher utility is retained, and then compared with the next alternative and so on. The pair-wise comparison continues until a final winning alternative is selected. This process ignores attribute weights and due to its binary order of comparing attribute differences, considers only the direction of the difference and not the magnitude (Russo & Dosher, 1983).

Poliheuristic. After studying high-ranking military officers, Mintz (2004) suggested the use of a poliheuristic strategy, a two-stage process utilizing cognitive heuristics followed by rational choice calculations. Especially when confronted with unfamiliar situations, he found that decision makers utilize a switch from dimension-based to alternative-based strategies during the decision process. Decision makers first use critical dimensions to eliminate alternatives utilizing a non-compensatory mechanism (meaning a good subjective estimate could not counterbalance a bad subjective estimate). Once the choice set has been reduced to alternatives that are acceptable to the decision maker, the process moves to a second stage, involving the evaluation of the surviving acceptable alternatives that minimize risk and maximize rewards. This choice theory has been even more pronounced in complex or unfamiliar decision settings, situations with low or high levels of ambiguity, and is said to explain why and how complex foreign policy decisions are made by world leaders (Bettman & Park, 1980; Mintz, 2004). Poliheuristic's unique characteristics—dimension based, noncompensatory, nonholistic, satisficing, and order sensitive—distinguished this "robust" theory from other decision making theories (Mintz, Geva, & DeRouen, 1994).

Satisficing. Most decision makers will search and settle for a good enough solution, which can lead to suboptimization or non-optimal solutions. Good enough or satisficing solutions may assure certain goal levels are attained, but, the rational solution to the simplified model may not be rational in the real-world situation. Simon (1978) first introduced the concept that rationality is bounded by limitations on human processing capacities and individual differences. Bounded rationality is why many models are descriptive, not normative (Payne, et al., 1993).

Recognition Primed Decision (RPD) Making. In theory, the NDM framework focuses on cognitive functions which emerge in natural settings and take forms that are not easily replicated in the laboratory. Researchers know that success with NDM processes depend on one's skill with decision making utilizing limited cognitive resources (Todd & Gigerenzer, 2001). Decision making under uncertainty, time-pressure, and stress—often encountered by military commanders and firefighters—occurs where there is not always time for careful consideration of each criterion for each alternative. It requires learning and expertise, leading experts to routinely choose feasible courses of action without analyzing all or even part of the options, as part of a singular evaluation process. When studying how people actually make decisions, Klein (1998) found that traditional normative and descriptive models of decision making failed to accurately describe this rapid decision-making under uncertainty. So Klein (1993; 1998) began a process of observing and retrospectively interviewing experts, as well as obtaining protocols, from urban fire ground commanders about emergency events they had recently handled. He soon theorized what has become known as the “prototypical NDM model” (Lipshitz et al., 2001, p. 335). After several years of his extensive post-incident analysis of personal testimonials from firefighters, military leaders, and others from occupations that often require rapid decisions, he discovered that the first course of action initiated and developed by experienced decision-makers is usually the one that can adequately solve the problem at hand.

According to the most basic strategy of Klein’s (1998) recognition primed decision (RPD) making model, experienced decision-makers conduct a singular evaluation process (a process where each alternative is evaluated on its merit), rather than conducting a comparative evaluation approach (i.e., comparing evaluation across multiple courses of action; Wolgast, 2005). Decision makers recognize the situation as typical (e.g., a room and contents fire, dumpster fire), and proceed to take the appropriate action. They understand the goals needed, cues are recognized, and they expect typical responses to their actions. Thus, a decision maker that uses RPD would only consider one alternative. They may review and consider information on several dimensions for that alternative, but would remain with their first option as a final choice. Secondary alternatives would not be considered with this strategy.

However, RPD allows for two other variations for more complex situations. The first variation occurs when the decision maker devotes more attention to gathering additional information, in order to better diagnose the situation. Further complications may arise if the decision maker misinterprets the situation and expectancies are violated. These are then resolved by utilizing RPD to check which interpretation best matches the specific situation. The final variation occurs when a decision maker anticipates difficulties and adjusts their course of action, even rejecting and looking for other options. Klein (1998) best described and categorized the three variations of RPD as follows: 1) “if…then,” with the decision maker recognizing and appropriately acting on the situation; 2) “if (???)…then,” with the decision maker struggling to identify the situation; and 3) “if…then (???),” where the decision maker struggles with the outcome of a reaction.

Though there has been admittedly “little work on the role of mental simulation in decision making,” Klein (1998, p. 26) determined that after initial recognition of the situation, decision makers do indeed perform mental representations of the situation. These additional investigative steps verify that their choice is correct and help them to look for unintended consequences; a strategy previously referred to as progressive deepening (de Groot, 1965). Yet, other theories of decision making have emerged that test RPD in concept. Nehmia, Mintz, and Redd (2000) and Mintz Geva, Redd, and Carnes (1997) found that familiarity may affect decision making when alternatives or dimensions are added to the choice set or dimension set in a dynamic way during a crisis. Shields (1980) found that as the complexity of a decision task increases, experts responded by utilizing a non-compensatory strategy, potentially contradicting Klein’s (2003) singular evaluation approach.

Weighted Additive. In this strategy, based on the multi-attribute utility model as described previously, the decision maker considers the values of each alternative on all the relevant attributes by multiplying the weight times the attribute value for each attribute and summing these weighted attribute values over all attributes. By considering the importance or utility of each attribute, and one’s willingness to tradeoff attribute values, the decision maker utilizing weighted additive is said to confront conflict, also known as compensatory. This normative strategy is considered to take significant cognitive demand, based on the necessity to develop an overall evaluation of each alternative (Riedl, et al., 2008).

Decision Characteristics

It would be disingenuous to describe decision strategies, without mentioning the defining characteristics. These general aspects of the decision process can greatly influence problem solving methods. Strategies can be described as either attribute- or alternative-based. In *attribute-based* decision processing—suggested as cognitively easier (Russo & Dosher, 1983)—the values of several options on a single attribute are processed before a further attribute is considered. In *alternative-based* decision processing, the attribute values of a single option are considered before moving to the next option for consideration.

Some decision strategies have been described as conflict confronting and others as conflict avoiding (Hogarth, 1987). This is explained by the decision maker's willingness to tradeoff more of one value's attribute for less of another valued attribute. *Compensatory* decision strategies, for example, are distinguished by the direct nature of its conflict confrontation due to the allowance of a low value on one attribute to be traded off for a high value on another attribute. Whereas, *non-compensatory* decision strategies avoid potential conflict in the decision process and do not allow for the tradeoff of valued attributes. For instance, lexicographic decision strategy is considered non-compensatory because a poor value on one attribute will ensure that that alternative is never chosen, no matter how high the value is on a different attribute. Whereas the weighted additive decision strategy is considered compensatory, because one attribute's high values can offset another attribute's poor values. Compensatory strategies may be avoided by most decision makers due to their requirements for increased cognitive effort and "explicit resolution of difficult value tradeoffs" (Payne, et al., 1993, p. 30).

Strategies can also be characterized by the extent by which they are found to be either *consistent* or *selective* across both attributes and alternatives. This variance in the amount of information examined can indicate a pattern of those that review all information for every attribute or alternative (consistent), or those that eliminate alternatives or attributes using only part of the information available (selective). Also, some decision strategies utilize *cutoff levels* (discussed earlier). These are value levels that a decision maker desires to attain; alternatives with attributes below these aspired levels are rejected, or effectively cutoff. In general, decision strategies that involve the counting, summing, subtracting, or multiplying of values are all considered to be *quantitative*, while those that do not are considered *qualitative*. For example, the weighted additive value requires the mental summing of values, and would thus be considered quantitative. In contrast, the mental shortcuts and heuristical reasoning described with a strategy such as elimination by aspect is more qualitative in nature. Table 1 presents a review of several common decision strategies based on the above characteristics.

Table 1: Decision Strategy Properties

Strategy	Alternative- (AL) or Attribute-based (AT)	Compensatory (C) or Non-Compensatory (N)	Consistent (C) or Selective (S)	Cutoff (aspiration) Levels Used? (Y OR N)	Quantitative (QN) or Qualitative (QL)
EBA	AT	N	S	Y	QL
LEX	AT	N	S	N	QL
MCD	AT	C	C	N	QN
POLI	AT/AL	N	S	Y	QL
RPD	AL	N	S	N	QL
SAT	AL	N	S	Y	QL
WADD	AL	C	C	N	QN

Note 1. EBA = elimination by aspect; LEX = lexicographic; MCD = majority of conforming decisions; POLI = poliheuristic; RPD = recognition primed decisions; SAT = satisficing; WADD = weighted additive.

Note 2. Payne, Bettman, and Johnson ((Payne, Bettman, & Johnson, 1993, p. 32) have classified EBA, LEX, MCD, POLI; SAT, and WADD. Klein (Klein G. , 1993) contributed RPD.

Note 3. Regenerated from Riedle, Brandstatter, and Rithmayer, 2008.

Experience - Novices vs. Veterans

Klein (1998) confirmed that RPD functions well in conditions of time pressure, and in which information is partial and goals poorly defined; RPD is less likely to be encountered with a lack of expertise (Lipshitz, 1993). There is a significant need for extensive experience among decision-makers (in order to correctly recognize the salient features of a problem and model solutions), and the problem of the failure of recognition and modeling in unusual or misidentified circumstances may lead to poor decisions. For firefighting, where it is "imperative that decision making is at an expert level," the ability to generate a rapid series of cognitive responses that lead to quick decision making seems ideal (Hintze, 2008, p. 26), and ensures that "experienced personnel can better predict fire behavior and make decisions to maintain personal safety" (Horn, 2006, p. 7). In fact, a decline "in experience necessary to properly assess the risks on the fire ground" has been suggested as a portion of the cause for increasing firefighter death rates (Foley, 2003, p. 7). Yet, according to Orasanu and Connolly (1993), "relatively little research has been done on the role of expertise in decision making" (p. 11), and understanding how people use their knowledge and experience in coping with complex decision tasks could help explain the fundamental differences between novices and veterans.

How should expertise be conceptualized? Camerer and Johnson (1991) suggest that an "expert is a person who is experienced at making predictions in a domain and has some professional and social credentials" (p. 196). To create a more functional definition it requires the assembly of several researchers' thoughts on expertise. Veterans, as opposed to others, exhibit a deeper, functional understanding of a problem (Anzai, 1991), consider the effects of sequencing and timing of events (Sefaty, MacMillan, Entin, & Entin, 1997), and know and can do what others cannot (Anderson, 1983). Klein & Militello (2004) suggested several additional categories of knowledge related to expertise, including those which:

- Hold increased perceptual skills.
- Possess a broader, deeper knowledge and experience, leading to increased ability to simulate mental models.
- Carry a large repertoire of patterns that allow them to recognize situations as typical.
- Know more facts and more details.
- Spend relatively more time analyzing a situation than deliberating a course of action.

- Better self-monitor for mistakes and limitations, leading to superior self-knowledge.

In cognitive psychology, developmental research based on detailed comparisons of experts and novices in specific domains began with deGroot's (1965; 1978) classic study of chess masters. This was soon followed by Chase and Simon's (1973) comparison of masters to less experienced players. A chess master's skill at reconstructing meaningful chess configurations is attributed to the fact that, through experience, they have come to perceive the game in terms of highly familiar patterns. As individuals gain knowledge, they hone their abilities to categorize information, recognize familiar patterns, and address critical indicators while ignoring less important features (Means, Crandall, Salas, & Jacobs, 1993). Likewise, Klein, Calderwood, and Clinton-Cirocco (1986) and Lipshitz (1989) reported that fire ground commanders and Israeli army officers respectively, react to situations in terms of highly familiar patterns associated with certain actions. Decision making in these environments appears to be determined by the "nature of the individual's experience, the patterns recognized, and associations between patterns and actions" (Means et al., 1993, p. 312).

Research suggests that situation recognition either from prior knowledge or expertise can lead to extremely expedient decision-making by remembering analogous situations, identifying relevant cues, and implementing the standard course of action (Warwick, McIlwaine, Hutton, & McDemott, 2001), and that the absence of preparatory experience weakens a capacity for making effective decisions (Useem, et al., 2005). Prior task knowledge and expertise in a problem domain have also been shown to be individual factors which can significantly affect how information is processed (Alba & Hutchinson, 1987; Shanteau, 1988). Payne et al. (1993) found that prior knowledge "obtained either through experience or training will determine which strategies are available to a decision maker in his or her memory" (p. 4). Thus, research suggests that veteran and novice performance is distinguished by how decision makers use their domain knowledge rather than by the ability to employ problem solving methods. When Lesgold, Feltovich, Glaser, and Wang (1981) compared the performance of 5 veteran radiologists with 18 radiology residents while examining X-rays and making diagnoses, the differences between the two groups lay more in pattern recognition and the ability to build rich mental representations of patient anatomy based upon the x-rays than in the decision processes utilized.

Veterans, unlike novices, perceive similarities in terms of fundamental laws or principles in a domain rather than in terms of superficial features (Chi, Feltovich, & Glaser, 1981). Omodei (2006) confirmed this while observing wildfire firefighters, where she found that experienced firefighters tend to look at smoke color for additional information about how a fire is burning, but lesser experienced fighters simply consider flame height. The differences between veterans and novices are even more pronounced when they are presented with reoccurring situations, where evidence shows that experts evaluate problems differently from novices (Horn, 2006). Experienced people are able to decide faster because the situation may match a prototypical situation previously encountered. This gives them the ability to recognize important features of a problem and to directly retrieve appropriate actions or solution techniques. Veterans thus spend relatively more time analyzing a situation than deliberating about a course of action (Kobus, Proctor, Bank, & Holste, 2000). Novices lacking this experience show the reverse trend. They spend less time on the dynamics of the situation and more time determining how to respond. They must cycle through different possibilities and have tendencies to use trial and error mechanisms. Unable to recognize a form of pattern matching, to multiple cues, or to correlate the pragmatic information with key observations, novices tend to employ an analytical approach, systematically comparing multiple options (Klein, 1993; Larkin, McDermott, Simon, & Simon, 1980). On the other hand, Dawes, Faust, and Meehl (1989) found that those with expertise do not always outperform others. Rather, it was those using an actuarial method of decision processing (the human judge is eliminated and conclusions rest solely on empirically-established relations between data and the condition or event of interest) who were found to be far superior regardless of experience.

Tradeoffs

Under normative decision-making theory, given a decision situation, all viable alternative courses of action and their consequences, or at least the probability and the values of the consequences, are known by the rational decision maker. Decision makers have an order or preference that enables them to rank the desirability of all consequences of the analysis. The chosen alternative is demonstrably the best of all, considered an o*ptimization* process.

However, in most given decision situations, all viable alternative courses of action and their consequences, or at least the probability and the values of the consequences, are not all known. This creates a potential tradeoff, where the time and cost of searching for an optimum decision is, in effect, traded off for the value of obtaining one. Though there are many aspects of a decision strategy that could be studied, the "difficulty of the tradeoff has received relatively little research attention in the decision-making literature" (Beattie & Barlas, 2001, p. 31). This is especially true as it pertains to the fire service. Klein (1998) addressed this, and after interviewing hundreds of fire personnel, stated that a review of the chains of events unfolding in the typical response to fire incidents emphasizes the need to address the effects of high tradeoff values on decision-making processes and choice.

A primary distinction among decision process and choice is the extent to which decision makers make tradeoffs among attributes. Luce, Payne, and Bettman (2001) write that "tradeoffs are clearly a fundamental aspect of choice….Unless trivial, decision makers must accept less of one choice attribute in order to get more of another" (p. 86). Because Hogarth (1983) has suggested that people find making explicit tradeoffs emotionally uncomfortable, decision strategies can be classified as conflict-confronting and others as conflict-avoiding (Hogarth, 1987; Payne, et al., 1993). Thus, decision makers may confront and resolve conflict by considering the extent to which they are willing to tradeoff more of one valued attribute (e.g., cost) for less of another valued attribute (e.g., safety). Firefighters occasionally find themselves faced with decisions that cause extremely difficult value tradeoffs, and many of these decision dilemmas provide no safe options. For example, an incident commander may (or may not) select an alternative line of action that increases risk to their subordinates in order to reduce risk to potential victims. If an incident commander immediately selects a safer alternative for subordinates, that decision may alternately increase the victims' risk, constituting a decision with high tradeoffs.

Perhaps no one in the fire service understands tradeoffs better than District Chief McNamee of the Worcester (MA) Fire Department who, on the night of December 3, 1999, courageously made the decision to stop firefighters from entering a cold storage warehouse fire to search a building that had already claimed (at that time) the lives of four firefighters (Marsar, 2009). Although two additional firefighters were ultimately lost during that tragic event, the risk assessment Chief McNamee performed certainly saved the lives of at least a dozen more. He used survivability profiling in the harshest sense. He knew that after losing radio contact and being out of air for more than 15 minutes in a windowless and fully engulfed building, the missing firefighters were beyond rescue. Chief McNamee faced a decision dilemma with extreme tradeoff values, and boldly made the tradeoff decision by essentially writing off the missing firefighters who were most likely beyond rescue by choosing not to risk the lives of the remaining firefighters who were willing to go back in to search for their lost brothers (Department of Homeland Security & Fire Administration, 1999; Marsar, 2009).

The use of a non-compensatory process (utilizing one or more attribute as a criterion for eliminating alternative lines of action, based on a defined acceptance threshold on the attribute) in multi-alternative choice "can lead to the elimination of potentially good alternatives early in the decision-making process" (Payne, et al., 1993, p. 5). Also, "people may avoid decisions that are difficult" (Beattie & Barlas, 2001, p. 31), or when they find outcomes are painful to compare (Frisch, Jones, & O'Brien, 1992), leading them not to maximize their utility (i.e., positive benefits).

Because the relative utility and weights to dimensions are seldom known to all, high tradeoff decisions are often explained in terms of losses and gains (Kahneman, Knetsch, & Thaler, 1991; Kahneman & Tversky, 1984). Nobel Prize-winning economists Kahneman and Tversky (1979) first discovered and documented the phenomenon of loss aversion. When events have high probabilities of occurring, people are typically risk-averse, but risk seeking in the domain of losses. When events have a low probability of occurring, the opposite is true; people are risk seeking for gains and risk averse for losses (e.g., lottery tickets and insurance). A decision maker is said to have a risk-averse attitude if he or she preferred a certain option to any risky prospect whose expected value is equal to or greater than that certain consequence. Conversely, a decision maker is said to have a risk-seeking attitude if he or she preferred the risky prospect over its certainty equivalent.

Hogarth (1987) argued that people often prefer not to directly confront the conflict of trading off more of one valued attribute for less of another, which is inherent in many decision problems. Thus, he suggests that people frequently use non-compensatory decision strategies as a way to avoid this conflict and the potential for loss. Lauriola, Levin, and Hart (2007) found some degree of consistency in decision making under risk and ambiguity, when reporting that decision makers faced with a choice with high tradeoff values, were more apt to choose an option with ambiguous outcomes when trying to avoid a loss than when trying to achieve a gain. It seems that when trying to achieve a gain, decision makers want as much discrete information as possible about the likelihood of a good outcome; but when trying to avoid a loss, they tend to be more tolerant of the uncertainty in the likelihood of a bad outcome.

Nearly half a century ago, Shepard (1964) was pessimistic about the possibility of measuring tradeoffs, but later became one of the first psychologists to address tradeoff value issues quantitatively. He suggested that when facing a decision task where alternatives have both advantages and disadvantages, the immediate sub-goal becomes reducing the emotional discomfort associated with the state of conflict induced by the decision problem. In developing the “accuracy-efforts” decision-making framework, Payne, et al. (1993) discovered two primary considerations underling contingent decision behavior; “the desire to achieve a good decision and the desire to minimize the cognitive effort needed to reach a decision,” known as the *accuracy-efforts* framework of decision making (p. 9).

Subsequently, while developing methods for measuring tradeoffs, psychologists have also discovered many common characteristics of decision makers. It seems that decision makers experienced more tradeoff difficulty when comparing attributes or dimensions that were dissimilar (Beattie & Baron, 1995) or when presented with decisions of morality (Beattie, 1988); people tend to ignore common features of choice alternatives and give more attention to unique features (Houston, Sherrill-Mittleman, & Weeks, 2001), and decision makers will tend not to employ strategies that require resolution of difficult value tradeoffs (Hogarth, 1987). It's been suggested that people sometimes use non-compensatory decision strategies to solve even simple decision problems "as a way to avoid conflict" (Payne, et al., 1993, p. 10), which becomes highly important because conflict has long been recognized as a major source of decision difficulty (Shepard, 1964). Thus, decision makers may avoid compensatory strategies not only because of the cognitive demand, but also because "they require the explicit resolution of difficult value tradeoffs (conflicts)" (Payne, et al., 1993, p. 30).

Time Pressure

Wright (1974), who wrote what is often considered the "by-far most influential early study of the effects of time pressure," suggested that complexity could be varied by changing the time available to make a decision (Edland & Svenson, 1993, p. 28). It can be generally considered that the greater pressure to make a choice in a restricted period of time, the less information the decision makers use in making their decisions (Rothstein, 1986; Wright, 1974). Time pressure, as this is called, is assumed whenever the time available for a task is perceived as being shorter than normally required for the activity (MacGregor, 1993; Svenson & Edland, 1987). Utilization of a more normative decision strategy may "exceed the information processing capabilities of even the most motivated decision maker under time pressure" (Payne, et al., 1993, p. 38). This can be problematic in dynamic decision-making occupations such as firefighting, where the *clock* is one of the main enemies. Useem et al. (2005) wrote, "Hesitation or equivocation may do more than delay a solution, and can radically compound the problem. In product markets, short-term can be months; in stock markets, days; in fire zones, hours" (p. 466).

Ariely and Zakay (2001) state that, "despite the importance and prominence of dynamic decision making, most of the decision-making research has focused on static decision tasks" (p. 195). Svensen and Maule (1993) found that there have been "comparatively few studies in the area of judgment and decision making under time pressure," creating a field "not mature enough for the development of a strong, unifying theory" (p. x). Bourne and Yaroush (2003) were surprised to "discover that the literature contains very little evidence on the effects of time pressure on cognitive performance" (p. 54). However, there have been attempts to address the effects of time pressure on choice and process (e.g., Dror, Busemeyer, & Basola, 1999; Ozel, 2001; Payne, Bettman, & Luce, 1996). Specifically, the negative effects of time pressure have been reported by many investigators (Ben-Zur & Breznitz, 1981; Edland & Svenson, 1993; Janis, 1982; Zakay, 1985). Svenson and Maule (1993) cited their concern that "there is no single tradition of time pressure research based on a common theory and body of empirical research" (p. 1), because time pressure research has been spread across the wide field of judgment and decision research.

Research exists to suggest that decision makers, when faced with time pressure, tend to react in one of three ways: (1) they tend to accelerate processing (Ben-Zur & Breznitz, 1981; Miller, 1960; Payne, Bettman, & Johnson, 1988); (2) they process only a subset of (what they perceive to be the) the most important information, referred to as filtration (Miller, 1960); or (3) they shift decision-processing strategies (Ben-Zur & Breznitz, 1981; Janis & Mann, 1977; Miller, 1960). To elaborate further, decision makers may take a step-by-step process in coping with increasingly more severe time pressure. First, there may be an attempt to speed up the information processing. When time pressure increases, and there is no possibility to process the information any faster, the decision maker resorts to a higher level of selectivity. When time becomes extremely short, the decision maker may then choose to change strategies in coping with the situation. Maule and Hockey (1993) divided these response modes into two distinguishable stages: micro-strategy changes (acceleration and selectivity) and macro-strategy changes (attribute-based, rather than alternative-based, strategies). Campbell and Austin (2002) confirmed these results when they found that adult subjects shifted from calculation-based or procedural strategies to a direct memory retrieval strategy to perform math problems under time pressure. Performance suffered as a result of this shift, especially as the problems grew more difficult.

The study of the effect of time pressure on judgment and decision making has produced varied results. Wright (1974) found that decision makers weigh negative consequences more heavily under time pressure, which could be related to the Easterbrook (1959) finding of a tendency to focus more on central information, while ignoring less central cues, while under time pressure. This was replicated by Ozel (2001), who found that extreme time pressure impeded performance by narrowing the range of environmental cues noted and processed. Rothstein's (1986) results paralleled these findings, in noting that the time pressure effect for differential cue utilization showed that time-pressured individuals tended to rely more on *one* of the cues than on two cues. Janis and Mann (1977) suggest that time pressure also leads to a shallower search for information, that is, an increased search across all alternatives and fewer searches in depth of the alternatives.

Time pressure has been shown to result in both negative and positive impacts on decision making. In examining how quantitative problem solving induced anxiety, Ashcraft (2002) demonstrated that math performance under time pressure only suffered when done by anxious subjects. However, when Mathews (1996) and later Kellogg, Hopko, and Ashcraft (1999) tested this theory further, they found that time pressure actually lowered the performance of *both* anxious and non-anxious subjects equally. Entin and Serfaty (1999) similarly found when investigating the effects of time pressure on decision making, that performance under time pressure was significantly less than performance under normal conditions. This was contradicted by Ozel (2001), who, when studying how the stress of fire threat affects how people process escape route information, actually reported that modest stress was beneficial to performance. Because some individuals perform worse under time pressure, while others actually excel (Hogarth, 1983), Ariely and Zakay (2001) felt this may indicate a very complex relationship between objective shortage of time and time-stress.

In the search for help for decision makers, a common finding among time pressure research is the use of heuristics. In attempts to reduce the cognitive load, the use of strategies that review some information on all alternatives (e.g., elimination by aspect and lexicographic) leads to improved accuracy (Payne, et al., 1988), and decision makers performed well in both moderate time pressure with large task size, and in severe time pressure with moderate task size (Payne, Johnson, Bettman, & Coupey, 1990). Zakay (1993) introduced a model that suggests that under time constraints, the decision maker automatically allocates resources to monitor time, and by doing so reduces the mental resources available to elevate decision making quality. His findings are supported by earlier work by Zakay and Wooler (1984), demonstrating that, while training improves decision quality in general, it does not result in improvement under time pressure. Because decision making under some equivalency of time pressure is a chronic part of many people's daily lives and professional activities, there is a "great applied need for increased research efforts in the research area for improved understanding and more knowledge about how to counteract the negative aspects of time pressure" (Edland & Svenson, 1993, p. 37).

Stress

Keinan and Friedland (1986, p. 219) found that a "growing body of literature attests to the inadequacies of choice models as descriptions of decision makers' actual decisions" (e.g., Einhorn & Hogarth, 1986; Kahneman & Tversky, 1979, March; Klein N., 1983; Slovic, Fischhoff, & Lictenstein, 1977). This is especially magnified with individuals in occupations who are expected to make decisions in time-pressured and risky conditions. Workers in these occupations are typically lauded when they perform to expectations; however it is not until they fail, often with spectacular disasters and crashes, "that the potential limitations of their decision making under stress are revealed" (Flin, Salas, & Martin, 1997, p. 3). Beattie & Barlas (2001) propose that "stress can influence decision strategy and judgments" (p. 31), suggesting a possible correlation between decision making and firefighter judgments that result in injuries and/or death. This seems plausible when a review of the history of emergency response yields a list of several catastrophes and disasters for which poor decision making was identified as a leading explanation for the magnitude of consequences (Vaughan, 1997; Turner & Pidgeon, 1997), however, this theory has not been tested due to the lack of appropriate technology.

Salas, Driskell, and Hughs (1996) adopted the following definition for stress: "Stress is a process by which certain work demands evoke an appraisal process in which perceived demands exceed resources and result in undesirable physiological, emotional, cognitive and social changes" (p. 6). Kowalski-Trakofler, Vaught, and Scharf (2003), who adopted the aforementioned definition in their work, highlighted the inconclusive literature on decision making under stress in presenting an overview of judgment and decision making for emergency managers. Seyle (1976), the scientist that helped introduce the concept of stress, defines it as: "The nonspecific response of the body to any demand" (p. 74). He himself admits that stress is a complex phenomenon, which depending on an individual's response to the stressor, may lead to either harmless stimulus or one that is threatening and dangerous.

For example, the 1949 Mann Gulch fire, where 13 firefighters died, was blamed on a series of failing leadership choices (Useem, et al., 2005; Weick, 1993). In response, the fire service created a development program using both classroom and experiential methods with the goal of explicitly enhancing decision-making skills, so responsible firefighters could make sound and timely decisions (TriData Corporation, 1998; National Wildfire Coordinating Group, 2002). However, years later, a series of suboptimal decisions by fire commanders tragically took the lives of 14 firefighters in a 1994 wildfire known as the South Canyon Fire. This fire has been considered by some as one of the gravest disasters of American wildland firefighters ever (Maclean, 2003). In the wake of this tragic event, Putnam (1995) proposed that an underlying cause of firefighter deaths may be "the difficulty individuals have to consistently make good decisions under stress" (p. 1).

Researchers at the National Institute of Standards and Technology (1998) suggest that "the ability to make decisions under stress represents what may be the single most important skill needed to improve firefighter safety" (pp. 1, Appendix C). Useem et al. (2005) found that tension is thus ever-present in a fire zone, and since team leaders carry personal responsibility for the lives of others, their stress can become acute" (p. 467). Sub-optimal decisions by firefighters have been traced to team leaders being specifically undertrained for leadership decision making when facing intense stress. For incident commanders, "both their reputations and the triple goals of safety, speed, and suppression are likely to be impaired by … acute stress" (Useem, et al., 2005, p. 467). Research confirms that when individuals are under time pressure while performing multiple tasks simultaneously, they are more likely to select sub-optimal choices, and much of the stress experienced by firefighters is a direct product of the immediate and various demands imposed on incident commanders when confronted by fast-moving fires (Finucane, Alhakami, Slovic, & Johnson, 2000; Gilbert, 2002; Janis & Mann, 1977). Janis (1983) explains that when the level of stress is very high, a decision maker is likely to display premature closure – making a decision without generating all the available alternatives.

However, empirical research suggests preparation, intuition, and training as methods to combat high levels of stress. A study by Fiedler (1992) of captains and lieutenants among urban firefighters, for example, found that the performance of seasoned officers actually improved under the stress of a fire, but the performance of less-prepared officers declined. The adverse effects of under-preparation on decision making become most pronounced under acute stress. A fire crew leader or incident commander who is relatively under-prepared for leadership may thus be expected to not make as good of decisions under the pressure they often experienced in front-line firefighting (Klein, 2003). Klein (2003) similarly concluded that intuition—if well-honed and informed by experience—improves decision making under stress. Wilkens (2006) writes that "more emphasis needs to be put on training firefighters to make sound decisions under stress" (p. 1); concluding that "better training is needed for decision making in stressful conditions." Additional research has been suggested to determine the "level of stress that will exceed an incident commander's 'operating envelope' and how they react under such conditions" (Flin, et al., 1997, p. 3).

Seyle (1976) argues that there are two differentiating forms of stress: bad stress (distress) and good stress (eustress), both leading to potential bodily changes. Blascovich and Tomaka (1996) presented a similar framework that differentiates challenge-stress from threat-stress states. Challenge stress is a state in which an individual feels they have the cognitive ability to deal with the situation, whereas in a threat-stress state they perceive a lack of cognitive skills required to cope with the decision task (Frankenhaeuser, 1986; Henry, 1980). Mendes, Blascovich, Hunter, Lickel, and Jost (2007) showed that these two stress states have different cardiovascular signatures. Challenge-related stress results in an increased cardiac output and a reduction in the total peripheral resistance blood pressure, to allow increased blood volume to the periphery and increased rate of blood flow to the brain and muscles. In contrast, a threat state presents a cardiovascular profile with reduced efficiency and increased vasculature resistance. Kassam, Koslov, and Mendes(2009) assigned participants to social feedback conditions designed to engender challenge and threat states, and showed that participants in the challenge group adjusted cognitively better than did those in the threat group, with this effect mediated by cardiovascular reactivity. Their work demonstrates the importance of considering profiles of cardiovascular reactivity when examining the influence of stress, emotion, and motivation on decision-making.

In studies of stress and human performance, researchers interested in changes in heart activity that can occur within cardiac cycles may use heart rate (HR) or heart rate variability (HRV) measurement (Andreassi, 2007). Heart rate is based on the number of times the heart beats per unit of time (i.e., beats per minute), calculated by counting the number of occurrences for the most prominent component of the EKG, the R wave. HRV is a measure of the stability of HR at a given time period of activity or inactivity, and is used to indicate level of awareness based on level of activation in the autonomic nervous system. For example, Walter and Porges (1976) suggest that attention-demanding tasks requiring information-processing result in less variation of HR with each reading. A HR deceleration and decreased variability are reported for both adults engaged in attention tasks and with infants at onset and offset of stimuli (Richards & Casey, 1991).

Short-time Fourier transform (Task Force, 1996) is applied on heart rate to gain HRV. HRV presents cardiovascular activity on a frequency scale. The high frequency range (0.15–0.4 Hz) of the power spectral analysis of HRV reflects parasympathetic influences on HR (nervous system that is responsible for relaxation; it is highly active when asleep or feeling relaxed), while the low frequency range (0.05–0.15 Hz) reflects both sympathetic and parasympathetic influences (very active when at high alert state). Consequently, an index of sympathetic modulation is the low frequency/high frequency ratio (LF/HF). Both chronic (Farah, Joaquim, & Morris, 2006; Lucini, Di Fede, Parati, & Pagani, 2005; Lucini, Silvano, Pizinelli, & Pagani, 2007) and acute (Castro, Novoselov, Morozov, Peres, Lopes dos Santos, Nillson, et al., 2007; Gianaros, Derbtshire, May, Siegle, Gamalo, & Jennings, 2005; Inagaki, Kuwahara, & Tsubone, 2004) stress can lead to activation of the autonomic nervous system which, in turn, leads to changes in HRV and blood pressure changes detectable by commercially-sold computers and other appropriate software to process signals generated by the physiological EKG measurement devices.

Virtual Reality

The fire service is experiencing fewer large fires than in the past and incident commanders are receiving less experience at the scene of large fires. Because the “fire ground is a very unforgiving learning environment” (Foley, 2003, p. 8) and opportunities for fire ground decision-making studies are becoming limited, computer-based simulators provide a means of evaluating incident commanders during a wide range of experiences, without putting them at risk or harming the environment. Dunn (2008) suggests:

> When you consider how long it takes a fire officer or chief to learn the… different aspects of firefighting, you realize there must be other ways to gain experience in making life-and-death decisions. The computer has given the fire service another way to learn life-and-death decision-making. The closest thing to making decisions at a fire is computer simulation decision-making training. (p. 3)

Simulation is an attractive alternative that provides repeated practice problems in artificially compressed time, is designed to build up recognition of patterns, and can be consistently adapted to the student in terms of difficulty level and instructional purpose (Means, et al., 1993). For example, in an air intercept task studied by Schneider (1985), computer graphic simulations and time compression were used to give prompt feedback and eliminate passive time that would most assuredly occur when training individuals under real-world conditions.

Interactive simulations have been found to be “particularly effective” (Payne, et al., 1993, pp. 235-247) in evaluating and training the decision-making skills; so much so that many influential organizations are highly recommending its use be integrated into firefighter incident commander training (Government Technology, 2003). The National Fallen Firefighter Foundation (2005) have suggested that there is a substantial need for effective integration of simulation into training to help firefighters identify the most critical and commonly encountered issues from actual incidents, and that developing virtual reality training scenarios would be the most appropriate method. Based on this need, the United States Fire Administration (2008) began working with NIST to develop a computer-based firefighter training tool “to improve training opportunities while lowering the cost and risk of death and injury” (p. 1). Even with the recognized potential, “The use of simulators is very limited in the fire service and there is substantial opportunity for enhancement” (National Institute of Standards and Technology, 2000, p. 35).

Virtual reality (VR) has been defined many different ways and can range from simple software programs presented on a laptop computer to fully immersive multi-sensory environments experienced with complicated head, vision, tactile or haptic-related instruments (Ausburn & Ausburn, 2004). When utilizing a three-dimensional computer-generated graphics system encompassing a majority of the user’s visual field, VR can mimic a natural setting while preserving the risk-free and uncontaminated qualities offered by controlled laboratory environments. Controls allow users to interact with the system, creating a virtual world where users feel fully encapsulated and more involved in the decision-making process. The result is a simultaneous stimulation of senses that can provide the user with a vivid impression of being immersed in a synthetic environment (Brown, 2001). While still being a fairly recent innovation, “research-based implementation of VR systems in industrial training…have a clean slate on which to write unique literature all their own" (Ausburn & Ausburn, 2004, p. 7).

Because NDM methodology does not always adhere to the standards of rigor appropriate for laboratory-based experiments, it has been criticized as being 'soft' (Yates, 2001). So, balancing the desire to study decision making in the natural environment of the decision maker, while still minimizing and/or eliminating the uncertainties and biases that laboratory studies introduce has been a challenge. Iowa State University's Virtual Reality Application Center (VRAC) offers a unique opportunity to employ highly-immersive VR technologies in a rigorous experimental lab environment, necessary to pursue naturalistic decision research. Utilizing both human-computer interactions, in conjunction with the development and implementation of a cutting-edge decision-tracing technology for emergency response simulations, represents a breakthrough in command and control decision-making research. The use of VR allows for: (1) development and utilization of a sophisticated real-time decision-capturing algorithm to trace decision-making processes in VR; (2) implementation of an array of virtual environments for firefighter interaction within a computerized automated virtual reality room where all six walls are utilized to establish the highest level of immersion; and (3) digitally recording simulations in the VR environment.

However, as Winn, Hoffman, Hollander, Osberg, Rose, and Char (1997) explain, for VR to successfully be used in this research, two areas must be addressed: (1) immersion; and (2) presence. VRAC utilizes the C6, an automatic virtual environment, to provide the illusion of *immersion* into a full-scale virtual world through projection of stereo images on the walls and floors of the room-size cube. The C6 system provides users with an unprecedented degree of immersion, through full enclosure within six 10' by 10' screens, isolating participants within its field of view. The C6 is the highest resolution VR system in the world; more than double that of any other similar system. Each screen projects representations with a resolution of 4,000 x 4,000 pixels, which is over twice the resolution of high-definition television (Iowa State University, 2008). By successfully isolating the user from the real environment and by creating realistic sensory inputs, full immersion into the virtual environment occurs. *Presence* means that users feel as though they are inside, interacting with the virtual environment; even a part of the virtual world. Users view the environment with shutter glasses, creating a high level of realism. Active stereo is used to control the perception of a participant's position and body in the virtual environment. Custom graphics programs, called shaders, render photorealistic objects and scenes in real-time to further increase a participant's presence. These items all synergistically create an environment that provides a high level of immersion and presence for the participants.

Decision Process-Tracing

The last four decades of cognitive investigation have witnessed the development of several methods to assist researchers with the identification and labeling of decision-making strategies (Riedl, et al., 2008). Known as metrics, these methods can include the proportion of information searched, the reacquisition rate (Jacoby, Chestnut, Weigl, & Fisher, 1976), variability in the amount of information searched per attribute (Klayman, 1982), the total amount of processing, the total amount of time spent on the information in the boxes, and the average time spent per item of information acquired (Payne, et al., 1993). For the purposes of the study, the metrics chosen include decision time (Hogarth, 1975), search index, variability in the amount of information searched per option (Payne, 1976), and decision strategy.

To help uncover some of the mystery behind identifying the decision strategy based on the cognitive process, process-tracing models were developed. These techniques specifically target the time between the onset of the stimulus and the decision maker's choice. Ford, Schmitt, Schechtman, Hults, and Doherty (1989) explain that process-tracing directly identifies what information was accessed to form a judgment and the order in which the information was accessed. This information can then be used to make inferences about what decision strategies have been employed in arriving at a choice and according to Ford et al. (1989), the examination of the decision maker's pattern of information search can "identify alternative models or strategies used in making a decision" (p. 77). Process-tracing studies present attribute values in an information display matrix, consisting of at least two options with corresponding attributes. At the beginning of the experiment, all the matrix boxes are closed. However, to obtain the necessary information about each option, the participant must open matrix boxes. While the participant opens a new box, the previous box closes, and so forth. So there is never more than one box open at a time. After a final decision is made, the researcher may analyze the acquisition process, and hopefully pinpoint a decision strategy. Previous studies using process tracing (Ford, et al., 1989; Payne, et al., 1993) have found that there are two 'pure' modes of information acquisition often used as a key dependent variable in studies using process-tracing methodology (Mintz, et al., 1997). The first pattern, an alternative-based strategy, occurs when the decision maker sequentially reviews all information for a given alternative across dimensions. This is opposed to the second pattern, a dimension-based strategy, whereby the decision maker focuses on a given dimension and reviews all the alternatives along this dimension and repeats the process for another dimension.

Over the last several decades, several different decision process-tracing techniques having been introduced and improved upon, varying from tracking eye movements (Just & Carpenter, 1976) to verbal protocols (Ericsson & Simon, 1980). However, Velichkovsky and Hansen (1996) suggest that evolving computer technology should enable interfaces to be developed that possess a special sensitivity to the states of attention and intensions of users. Computerized process tracing is not novel, in the early 90s Payne et al. (1993) introduced Mouselab, and after the turn of the century Jasper and Shapiro (2002) introduced what they considered an improved version called MouseTrace™. Along those same lines, VirtuTrace™ provides a modern and robust computerized decision process-tracing methodology that can be utilized to automate the recording of the participant's decision processes. As can be seen in Figure 1, the core structure of VirtuTrace™ is a matrix of decision alternatives (Ai's) and decision dimensions (Di's), a

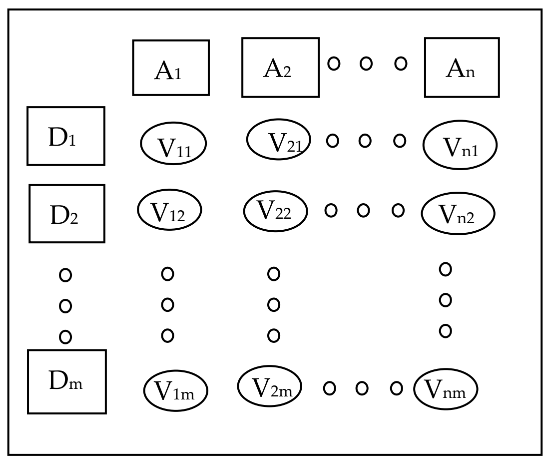


Figure 1: Layout of a Typical Decision Matrix.

platform similar in principle to Mouselab™ (Payne, et al., 1993), and used intensively in decision-making research (Keren, Mills, Freeman, & Shelley, 2009; Mintz, 2004; Mintz, 2005). The 'values' in the matrix (Vij's) represent the evaluation of alternative i on dimension j. Participants can open these information boxes to reveal their contents, whereas decisions are made by clicking on the choice box of a desired alternative (Mintz, et al., 1997). The implementation of the decision matrix in VirtuTrace™ varies from other methods and will be described in the Methodology section.

Summary

Vast and significant studies exist regarding decision making, as can be seen from the previous literature review. However, there are still gaps in the research. The literature review suggests that experience is a critical factor in decision making. In fact, a decline "in experience necessary to properly assess the risks on the fire ground" has been suggested as a portion of the cause for increasing firefighter death rates (Foley, 2003, p. 7). Research appears conclusive that there are pronounced differences between veterans and novices, and situation recognition either from prior knowledge or expertise can lead to extremely expedient decision-making. However there still exists much controversy over whether those with expertise always outperform others and always make the correct decision (Dawes, et al., 1989).

The literature review in the field of tradeoffs, revealed many deficiencies and gaps. Beattie and Barlas (2001) have penned how the "difficulty of the tradeoff has received relatively little research attention in the decision making literature" (p. 31). Much controversy still exists regarding the field of tradeoffs and relatively little material has looked at how tradeoff variations affect decision choices. The difficulty encountered in mimicking high tradeoff situations has been problematic with this challenge. Again, recent technological developments in virtual reality's naturalistic-like settings will help study tradeoff, while preserving the quality of a controlled laboratory settings and a safe environment.

Edland and Svenson (1993) wrote of a "great applied need for increased research efforts in the research area for improved understanding and more knowledge about how to counteract the negative aspects of time pressure" (p. 37). Beattie & Barlas (2001) propose that "stress can influence decision strategy and judgments" (p. 31), and other relevant literature suggest a possible correlation between decision making and firefighter judgments that result in injuries and/or death. However, there is a need to determine the actual relationship between acute stress and decision-making processes in firefighters, and to further evaluate how stress can interfere physiologically with the decision maker under stressful situations.

One of the concerns is the method employed by researchers to gather their information. Much of this work is obtained similarly to Klein's (1993) method, the utilization of verbal protocol to analyze and identify decision strategies. Understanding that this method "often yields unreliable data on decision processes due to memory distortion, interpretation, and an inability to recall facts," it appears that researchers have struggled to evaluate firefighters' decision making in real-time, under naturalistic conditions (Riedl, et al., 2008, p. 796). Improved technology now allows the utilization of human-computer interactions via virtual reality technology in conjunction with decision-tracing technology to examine firefighters' decision making through simulations in real time. These technological developments provide naturalistic-like settings while preserving the quality of a controlled laboratory settings and a safe environment, hence facilitating the opportunity to overcome the challenge. This work presents the process and the results of conducting decision making under stress experiments with firefighters in virtual reality. More specifically, the experiments address difficult tradeoff levels and time pressure, well-recognized stressors among firefighters.

CHAPTER 3: METHODOLOGY

Overview

The importance of properly identifying the distinct and commonly misunderstood fire phenomena – backdraft and flashover – as two of the most dangerous changes that rapidly occur throughout a compartment fire, cannot be overemphasized (Gorbett & Hopkins, 2007). Cote (2004) proposes that both backdraft and flashover are well-reviewed and documented scenarios encountered by firefighters. There is convincing evidence of the challenges these scenarios impose: Of the firefighters who are killed by smoke inhalation, approximately 26% are caught in a rapidly-spreading fire, backdraft, or flashover (Foley, 2003). Of those who die from secondary burns received from a structure fire, approximately 45% are caught in, or trapped by a backdraft or flashover (Foley, 2003). Thus, fire safety professionals must truly understand and grasp all the components of enclosure fire behavior to succeed at their mission of saving lives.

Furthermore, pre-backdraft and pre-flashover present two different firefighting settings: pre-backdraft is a stagnant scenario where the “scene” does not change until a backdraft occurs. Pre-flashover is a dynamic scenario where a small fire in a structure (termed *incipient fire*) progresses to consume significant content of the structure; eventually hot and flammable gases accumulate to a level where they combust at once (flashover). The distinctive characteristics of these scenarios serve very well to address two of the conditions proposed in this study (described below).

The methodology for this project entailed studying the effect of tradeoff values (Experiment 1), time pressure (Experiment 2), and experience (in Experiments 1 and 2) on choices and processes leading to decisions in firefighters. These two experiments involved the two diverse stages of fire, (a) pre-backdraft and (b) pre-flashover, respectively.

The Facility

To facilitate simulating these fire phenomena, the experiments were administered in a 3D fully-immersive virtual reality environment at the Virtual Reality Applications Center

(VRAC) of Iowa State University. VR at VRAC refers to six projection surfaces where stereo graphics are used with three-dimensional viewing displayed large enough to encompass all of the user's visual field. Input devices and controls allow the users to interact with the VR system. These input devices include shutter glasses, a tracking system for tracking users' head positions and location, and a handheld device with a variety of controls (the wand). This VR system is termed C6. The C6 is a 10'X10'X10' closed room where the back wall is retracted to allow user access to the room. Fifteen ultrasonic sensors are installed along three corners of the ceiling. The sensors follow the head-tracking sensor (located on top of the shutter glasses) and the tracking element in the wand.

The Process

Once the participants arrived to the C6, they were provided with a confidentiality agreement and consent explanation form and were given time to ask questions and receive satisfactory answers. If participants indicated continued willingness to participate in the study, they were asked to sign this two-page informed consent release. All subjects were verbally informed of the intent and procedures of the study with written consent obtained prior to data collection. All protocols and procedures were approved by the Institutional Review Board of Iowa State University. A copy of the signed form was later provided to each participant via e-mail. At this time, participants were seated at a table, briefed on the process, and any questions or concerns were answered. EKG electrodes were then attached to the participant's torso, and a blood pressure monitor was attached to the participant's finger. Baseline heart rate and blood pressures were obtained prior to participating in the experiments; when ready, participants were led into the virtual reality simulator (C6) to begin the study process. A FlexComp™ system sampled heart rate at a frequency of 2 KHz, and a Finapres™ system sampled blood pressure at a rate of 500 Hz.

Following a general oral introduction about the subject of the study, participants were briefly coached in the procedures for operating and navigating through the virtual reality simulator. To establish naturalistic-like environment, a position-to-velocity (P2V) algorithm was established. The P2V allows motion in the Virtual Reality Environment (VRE) based on the location of the user in the C6; thus, eliminating the need of using a joystick for establishing motion. To move in the VRE, the user first established a point of origin by pushing a button on the wand. Then, when the user moved it in a certain direction, it makes the VRE move toward the user in this direction. The larger the distance of the user from the point of origin, the faster the environment moves in their direction. Retracting back toward the point of origin will slow the environment, and retracting completely to the point of origin will cease the movement of the VRE. A maze scenario was created to train the user with the navigation system. Navigating through the maze required 8-15 minutes based on the speed the participants acquired the skills.

Before beginning the experiments, participants completed two training scenarios that introduced them to the principles of using the decision matrix in the VRE. In the first scenario the participants are asked to make a decision on which car model to buy from four models presented to them in a virtual car dealership setting. Similarly, the second training scenario requires deciding which bike model to purchase among four models available. The decision matrix can be drawn at any point by pushing a button on the wand. The matrix is presented in front of the participant and a red dot appears in front as well, perpendicular to the user's forehead. The red dot tracks users' head movement allowing the user to select information bins on the matrix by looking at the bins and pushing a button on the wand. When information bins are selected, users hear a salesperson describe the evaluation of a dimension on the alternative selected, similar to the response the user would hear from a salesperson on the dealership floor. When ready, the subjects look at the favorite alternative and finalize the decision by a push of a button on the wand. Figure 2 consists of an image taken from the car dealership scenario, presenting the decision matrix as viewed in the VRE.

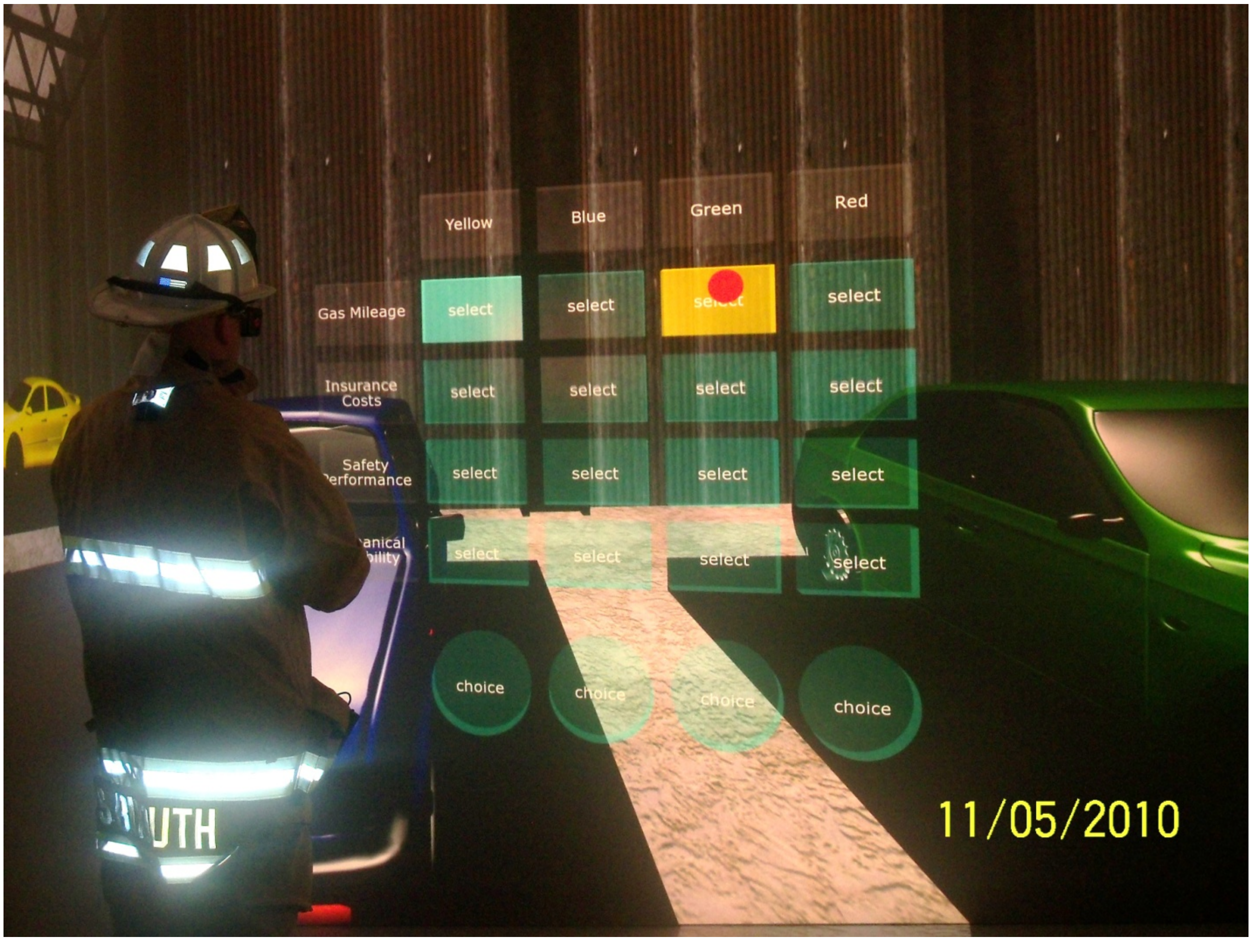


Figure 2: View of Matrix in Virtual Reality.

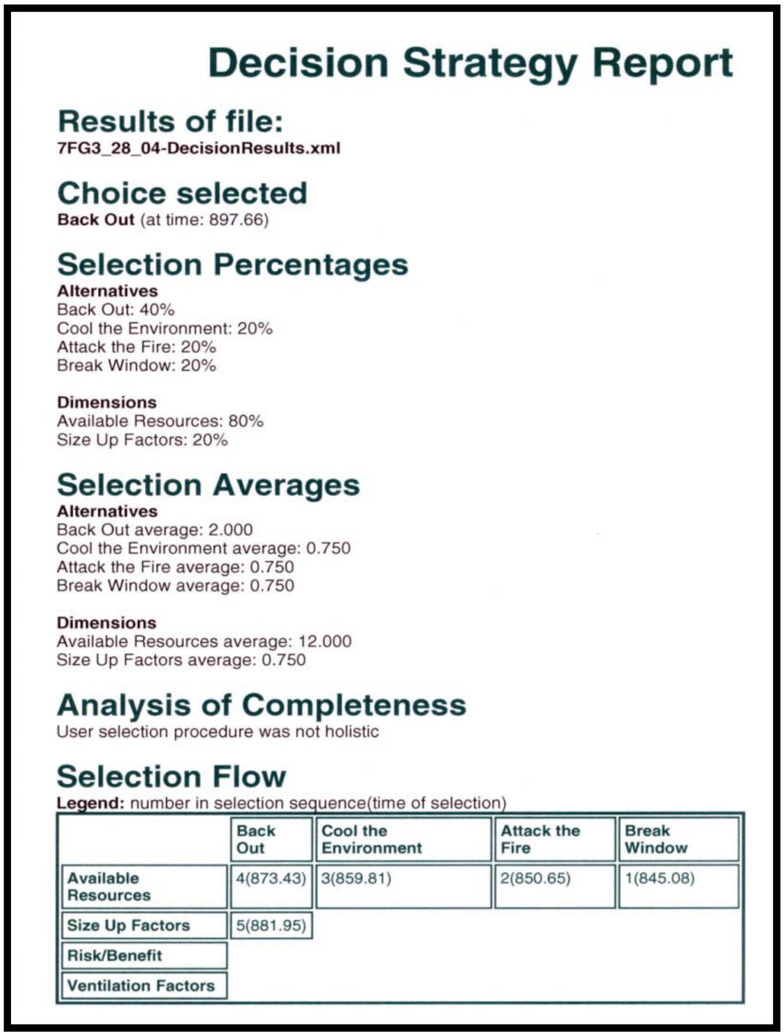
The first training scenario is guided, allowing the users to gain experience with using the tools and the environment and to ask questions while being trained. In the second scenario, the participants are left by themselves, with the C6 retractable door closed behind them. After completion of the training scenarios, each participant moved next to the two firefighting experiments. Between the first and the second experiments, each participant was provided with a short questionnaire (e.g., gathering information on cue identification) regarding the first experiment (see Appendix A for questionnaire, and Appendix B to view completed questionnaires). The same questions were asked of the second scenario, but this was done as a part of a summary online survey (see Appendix C) that was completed upon finishing the experiments. The survey consisted of several demographic, scenario-specific, and assessment questions regarding the scenario's complexity, difficulty, and realism. The system described above allows utilization of virtual reality technology in conjunction with decision-tracing technology. This system was developed by Dr. Nir Keren's research group and is termed VitruTrace™.

Experimental Design

For these experiments participants selected information to review and made their final choice using a decision-making matrix as described earlier. The matrices for the two experiments were developed over months of gathering information and testing for the validity of this information. The matrices included information that users could not gather from the environment. Information from the decision matrix was revealed audibly when interacting with the decision matrix. When the information was revealed audibly to the participant, it mimicked the sound heard over 'walkie-talkies' utilized in actual live fire communication. The information matrix was described to the participants as an element that replaces their radio for communication. To help control for biases associated with the order in which alternatives and dimensions were presented, the design included several orientations of the decision matrix, in which the order of presentation of the alternatives and dimensions were manipulated.

The virtual reality system VirtuTrace™ utilized a decision-process tracing methodology to record the decision processes and the sequence in which information was acquired. VirtuTrace™ provided technology for collecting the following information during the experiments: (1) the sequence in which firefighters acquired information; (2) the number of items that firefighters viewed for every alternative along each dimension; (3) the amount of time elapsed from the time respondents began the task until they made their choice; (4) when and how long information bins were reviewed, (5) and the alternative that was ultimately selected.

VirtuTrace™ included a decision-parsing system that analyzes and presents a subject's 'decision portrait'. The portrait includes calculated search indices for each of the decision process dimensions and alternatives, amount of information reviewed, time spent in distribution throughout the decision task, and cognitive maps that are used to identify decision strategies. Figure 3 presents a sample of a decision portrait. The portraits provide vast information, some for purposes other than that of this study.



Decision Strategy Report

Results of file:
7FG3_28_04-DecisionResults.xml

Choice selected
Back Out (at time: 897.66)

Selection Percentages
Alternatives
Back Out: 40%
Cool the Environment: 20%
Attack the Fire: 20%
Break Window: 20%

Dimensions
Available Resources: 80%
Size Up Factors: 20%

Selection Averages
Alternatives
Back Out average: 2.000
Cool the Environment average: 0.750
Attack the Fire average: 0.750
Break Window average: 0.750

Dimensions
Available Resources average: 12.000
Size Up Factors average: 0.750

Analysis of Completeness
User selection procedure was not holistic

Selection Flow
Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources	4(873.43)	3(859.81)	2(850.65)	1(845.08)
Size Up Factors	5(881.95)			
Risk/Benefit				
Ventilation Factors				

Figure 3: Decision Portrait.

Physiological Responses

Scientific methods are often employed to study changes in heart activity, not only during stressful situations, but also in the performance of problem-solving tasks (Andreassi, 2007). To identify states of stress in the participants, it was necessary to establish cardiovascular portraits by recording changes in heart rate and blood pressure [see Kassam, et al., (2009) for cardiovascular signatures of stress in decision making]. To obtain heart rate measurements, four electrodes were placed on each participant's thoracic region. Blood pressure was obtained via a participant-tethered finger cuff. Essential resting baseline measurements were obtained, serving as a reference point against which changes were compared (Piferi, Kline, Younger, & Lawler, 2000).

Once the experiments began, physiological EKG measurements were obtained as describer earlier. To analyze the data, acquired physiological measurement and decision process tracing information from the virtual reality events were merged onto the same timeline.

For the purposes of this study, changes in minimum and maximum heart rate (HR) and blood pressure (BP) were calculated. The maximum increases in HR and BP were calculated as the maximum HR and BP values in the scenario minus the baseline values. These were then normalized to the baseline values, as shown in Equations 1 through 4.

$$\triangle HR_{max} = \left(\frac{HR_{max} - HR_{base}}{HR_{base}}\right) * 100 \tag{1}$$

Where $\triangle HR_{max}$ is the normalized maximum HR change during the scenario, HR_{max} is the maximum HR value measured during the scenario, and HR_{base} is the baseline HR that was established prior to the experiments.

Equation 2 shows how the maximum decrease in HR was calculated similarly.

$$\triangle HR_{min} = \left(\frac{HR_{min} - HR_{base}}{HR_{base}}\right) * 100 \tag{2}$$

Where $\triangle HR_{min}$ is the normalized minimum HR change during the scenario, HR_{min} is the minimum HR value measured during the scenario, and HR_{base} is the baseline HR that was established prior to the experiments.

As seen in Equation 3, calculation for changes in BP followed the same principle.

$$\triangle BP_{max} = \left(\frac{BP_{max} - BP_{base}}{BP_{base}}\right) * 100 \tag{3}$$

Where $\triangle BP_{max}$ is the normalized maximum BP change during the scenario, BP_{max} is the maximum BP value measured during the scenario, and BP_{base} is the baseline BP that was established prior to the experiments.

Equation 4 also shows how the maximum decreases in BP were calculated.

$$\triangle BP_{min} = \left(\frac{BP_{min} - BP_{base}}{BP_{base}}\right) * 100 \tag{4}$$

Where $\triangle BP_{min}$ is the normalized minimum BP change during the scenario, BP_{min} is the minimum BP value measured during the scenario, and BP_{base} is the baseline BP that was established prior to the experiments.

Experiment 1

Rationale

Firefighters face extreme tradeoff decisions, often on a daily basis. Each time an incident commander chooses to enter a structure on fire, a tradeoff is made since subordinate firefighters are put at risk for increasing the probability of improving a victim's odds of survival. The prospect of a loss of firefighter life is traded off, so to speak, for the potential to save another's life.

Firefighters are often taught in training what has become the fire service's unofficial risk benefit guideline - *risk a lot to save a lot, risk little to save little, risk nothing to save nothing*. This attempt at balancing tradeoffs in decision making assists incident commanders to implement a rule of thumb decision, but may not account for the ability of an incident commander to identify conditions where "a lot to save" is actually present.

To study the effects of tradeoff on decision-making process and choice, the pre-backdraft scenario implemented two tradeoff levels. The scenario was carefully chosen, taking into account that backdraft is a familiar (not necessarily experienced, but referred to often in training) and yet challenging scenario for firefighters (Cote, 2004). Backdraft is most simply defined as the “rapid deflagration following the introduction of oxygen into a compartment filled with accumulated unburned fuel” (Fleishmann, 1994, p. 21). The potential for backdraft occurs when a fire's product-gases are starved of oxygen; combustions slows but the smoke and gases remain at an elevated temperature. Limited ventilation during an enclosure fire can lead to the production of large amounts of un-burnt gases. When an uncontrolled opening is introduced, the inflowing air may mix with these gases, creating a combustible mixture. Any ignition sources, such as a glowing ember, will ignite this flammable mixture, resulting in extremely rapid burning gases flowing out through the opening, and causing a fireball outside the enclosure, often referred to as a backdraft (Quintiere & Karlson, 1999). Thus, if oxygen is reintroduced into the fire by opening a fire-level door or window, combustion can restart, often in a rapid and explosive manner. The accepted method for eliminating or at least reducing the odds of a backdraft occurring is to ventilate (open a hole in the structure) at the highest vertical point directly over the seat of a fire as possible, allowing the gases to naturally escape without ignition. Failure to do so, coupled with the introduction of air through a horizontal opening (e.g., open/break window or door) can result in the explosive ignition of the superheated smoke and gases. It is important to note though, that pre-backdraft conditions are stagnant and not time dependent (i.e., the situation does not change with time).

Scenario

The scenario for Experiment 1 begins with the participant assuming the position of the incident commander who has been dispatched and arrived on the scene of a reported structure fire. On fire is a single-family dwelling suggestive of a home found in a typical suburban middle to upper-middle class neighborhood (see Figure 4), with a driveway, front and back yard, and other amenities typical to these types of dwellings. There are no visible flames, but thick black smoke, distinctive of incomplete combustion can be observed "puffing" and "sucking" from the doors, windows, and eaves of all sides of the residence. This is typical of a highly "charged" or pressurized smoke-filled interior. The windows are opaque, typically a result of internal smoke and soot stains. The front and back doorknobs are glowing red, suggesting unusually hot conditions on the interior of the doors. Each of these indications in and of themselves is not unusual, but together they are distinctively characteristic of potential backdraft conditions.

Figure 4: Single Dwelling Residence Fire in the Pre-Backdraft Scenario.

For this experiment, tradeoff levels are manipulated by altering the cues portraying the presence of occupants. Participants encountering the scenario with *high* tradeoff values (most likely to "risk a lot to save a lot") were provided the aforementioned scenario indicative of a home presently occupied: a vehicle in the driveway, empty mailbox and a clean walkway. Participants in the *low* tradeoff values scenario ("risk a little to save a little") viewed a house with no car in the driveway, mail overflowing in the mailbox awaiting pickup, and numerous newspapers on the front stoop, providing strengthening indication that the door has not been opened in several days and the house may be presently unoccupied. These cues provided participants with either strong or weak indications that there may be viable victim(s) in need of rescue, and subsequent actions by participants could either greatly improve or decrease the odds of successful rescue. The experiment includes level of experience as an independent variable as well.

Experiment 2

Rationale

Prior to 1991, the term backdraft was known only to firefighters and a handful of fire behaviorists. After Universal Studios released its major motion picture entitled "Backdraft" in 1991, the term became a household word. However, there exists a similar dangerous phenomenon that unlike backdraft, has received very little attention from the mainstream media, *flashover*. The National Fire Protection Association (2004) defines flashover as:

> A transitional phase in the development of a compartment fire in which surfaces exposed to thermal radiation reach ignition temperature more or less simultaneously and fire spreads rapidly throughout the space resulting in full room involvement or total involvement of the compartment or enclosed area. (p.11)

Flashover is a rapidly-occurring transitional event in the development of a compartment fire. It represents a significant increase in fire growth from a particular source of burning or single fuel package to the ignition and ultimate burning of virtually every other exposed combustible fuel surface in the compartment. This is a complex and dangerous condition that has taken the life of many firefighters. According to Grimwood (2003), statistics recorded in the United States between 1985 and 1994 demonstrated that a total of 47 US firefighters lost their lives to flashover. Gorbett & Hopkins (2007) stress that many articles on the flashover phenomenon are technically inaccurate, resulting in a significant percentage of firefighters who continue to die in this country each year due to poor knowledge and training regarding enclosure fire behavior.

Scenario

Experiment 2 addresses the effect of time pressure on decision making. In the experiment, participants were located inside of a structure where conditions were indicative of incipient fire slowly or rapidly progressing to pre-flashover conditions (e.g., fire in an enclosed point of origin, dense stratified smoke with rapid development from the ceiling level downward, fire rollover from room of origin). Participants begin the scenario directly inside of the front door. Ahead of them is a living room fire, originating from the floor. The room of fire origin has several large pieces of furniture (e.g., couch, love seat, table, lamp), providing a substantial fuel load, and increasing the risk for full fire involvement or flashover. If the participant makes a determination to move through the home, there is also fire in the back bedroom, also originating from the floor level.

The longer a participant takes in assessing the situation or reviewing information, the greater the potential of a flashover. Thus, the scenario is dynamic and suitable for controlling time pressure. Time pressure was manipulated by altering the speed at which the smoke accumulated (moved downward from the ceiling) and by increasing the density of the smoke (the smoke became denser as it accumulated). Increased smoke density indicated an increase in gas' flammability. When smoke accumulated low enough, the participants were forced to move to their hands and knees to maintain visibility. If a final decision was not made while visibility was reasonable, all visibility would be lost, indicative of imminent flashover (near simultaneous ignition of all combustible material in an enclosed area). It is this loss of visibility and awareness of surroundings that often results in firefighter entrapment and resultant post-flashover fatalities (Gorbett & Hopkins, 2007). Figure 5 provides a snapshot from Experiment 2.

Figure 5: Pre-Flashover Scenario.

The independent variables in this experiment were time pressure and experience. Time pressure was manipulated by altering the time it took the smoke to accumulate from the ceiling to the floor. In the low time pressure, this time period was set to 3 minutes. In the high time pressure the time period was set to 1 minute. An incipient fire (only seed fire exists) will go to a whole structure fire engulfment in approximately five minutes (Cote, 2004). Thus, the difference between one and three minutes provided a significant difference in time pressure. Furthermore, the rate of smoke accumulation in pre-flashover conditions is not linear (Feng, Hadjisophocleous, & Torvi, 2000). Therefore, a quadric equation was used to increase smoke accumulation rate as a function of time.

As in Experiment 1, dependent variables included the time each participant took to make a decision, the amount of information processed, search indices, the decision strategy, and the final choice. Decision portraits from both Experiments 1 and 2 are available in Appendices D and E, respectively.

Statistical Inference Procedure

The dependent variables in this study consisted of three process-tracing parameters of decision making, and other information as follows: (1) information search pattern (alternative-based vs. dimension-based search indices; (2) the decision strategy; (3) the amount of information processed (number of informational cells processed); (4) the time utilized from the start of the experiment to the decision point; (5) the final choice; and (6) stress. Independent variables included tradeoff (Experiment 1), time pressure (Experiment 2), and experience (both Experiments 1 and 2). The values of search indices were produced for each participant. Two-way analysis of variance (ANOVA), logistic regressions, and *t*-tests were used to determine statistical significance main effects of each of the treatments separately on each dependent variable. $P < .05$ was used for accepting high significance, and $0.05 < p \leq 0.10$ for moderate significance.

Analysis of covariance (ANCOVA) was required often in the analysis. Utilizing ANCOVA allowed for "adjusting" comparisons between groups for imbalances in important prognostic variables between these groups. When performing this general linear model, a continuous quantitative outcome variable (e.g., time to decision, information processed, search indices) was used and two or more predictor variables where at least one is quantitative and continuous (e.g., time to decision, information processes, search indices) and at least one is a nominal categorical (e.g., tradeoff, experience). ANCOVA tests whether certain factors have an effect on the outcome variable after removing the variance for which quantitative predictors (covariates) account. Since ANCOVA is based on linear regression, the relationship of the dependent variable to the independent variable(s) must be linear in the parameters.

A portion of the analysis of the decision-making processes required quantification of the order and the direction at which information from the decision matrix was processed. To facilitate this quantification, Billings and Scherer’s (1988) method to score information processed was adopted. According to this scoring scheme, each move to a new information bin, which is along the same alternative and across dimensions, is classified as an alternative-based move; a move along a dimension and across alternatives is labeled as dimension-based. Moves to both a different alternative and a different dimension are labeled shifts. The search pattern variable, the Search Index (SI), according to Billings and Scherer (1988) is defined as the ratio between the number of alternative-based moves minus the number of dimensional moves, divided by the sum of these two numbers. The index tallies the number of dimensional moves (*d*), alternative moves (*a*), and shifts (*s*) (moves that are not alternative or dimension based) according to Equation 5:

$$SI = \frac{(a-d)}{(a+d)} \tag{5}$$

Where **a** represents the number of moves to a new information bin (in the decision matrix) within the same alternative and across dimensions, and **d** represents the number of moves within a dimension and across alternatives.

Positive SI (search indices) implies a more alternative-based search pattern, and negative numbers imply a dimensional pattern. Shifts are disregarded from this index. See Appendix F to view the information search matrices for both Experiments 1 and 2.

Ecological Validity

To lend ecological validity to the proposed study, a focus group of five highly-experienced (*M* = 21.2 years of service, *SD* = 4.44) career fire ground commanders was established and invited to critically evaluate the environment, experimental designs, and the decision matrices. In an oral post-experiment focus group questionnaire (see Appendix G), all participants reported immersion to the point of unawareness of the real world and involvement so intense that they lost track of time during the experiment (this often occurs to incident commanders during 'real' fires). During the focus group session, the participants offered some suggestions to help improve the clarity and scenario realism that were later implemented into the experimental process. The focus group strongly supported the validity of the environment and the experimental design. To further enhance and validate the process, Dr. Bethany Weber, a cognitive psychologist at Iowa State University was invited to experience the experiment with several of her suggestions being implemented.

Participants and Demographics

The population in this study was career firefighters in the United States. All the participants were Iowa-based, full-time career (not volunteer firefighters) fire department personnel who took part as voluntary (not paid to participate) participants in this experiment. Participants were selected by means of a convenience sample from the Ames and surrounding Des Moines metro-area fire departments. No incentives were offered or provided to participants. Several appointment times were proposed to accommodate subject availability.

The following demographic information was common to both Experiments 1 and 2. The sample consisted of 61 males and 1 female, for a total number of 62 participants. Participation was in the range of 90 to 120 minutes long; this time frame included preparation time, completing training scenarios, participation in Experiments 1 and 2, and completion of the survey. A brief summary of the survey results follows (see Appendix H for more thorough survey results). The age of participants ranged from 21 to 60, with an average of 39.31 years old (*SD* = 10.03). The subject list included 6 fire chiefs, 6 chief officers, 4 captains, 8 lieutenants, and 38 firefighters. No participants were excluded from either experiment, though one declined (female) and two others (males) reported susceptibleness to motion sickness during the training scenarios (experienced vertigo and malaise); these three are not included among the 62 who completed the process. All participants were individually tested during the months from April 2010 through June 2011, after ensuring appropriate consent procedures. Participants included one of African American decent (~2%), two of Hispanic origins (~3%), and 59 Caucasians (~95%). Though several of the younger participants had some "gaming" experience (i.e., Wii, Playstation, X-

Box, etc.), none of the participants shared that they had partaken in any type of virtual reality experiment before.

Experience

The majority (61%) of the participants were firefighters (*n* = 38); others were company-level officers (*n* = 8), station-level officers (*n* = 4), or chief-level officers (*n* = 12). All participants had completed some college, with more than 25% (*n* = 16) having obtained an associate's degree and more than 35% (*n* = 22) having completed undergraduate studies. Firefighting experience ranged from less than one year (*n* = 2) to 35 years (*n* = 1), with the mode for experience being five years, and average of 13.84 (*SD* = 8.36). Figure 6 presents a histogram for experience level and Table 2 presents a summary for experience level. The histogram shows the upper and lower 95th confidence intervals for the mean.

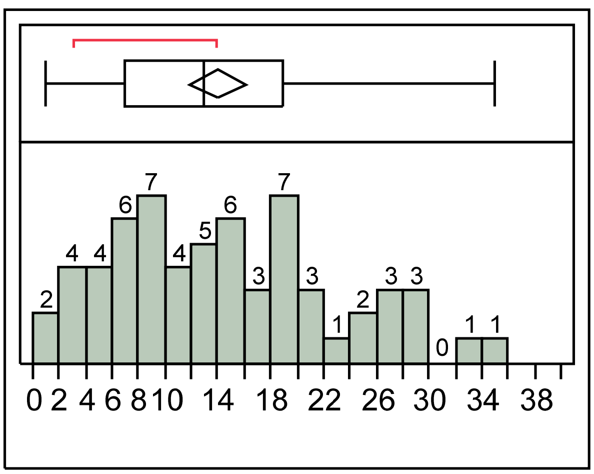


Figure 6: Distribution of Years of Experience.

Table 2: Summary of Years of Experience

M	13.84
SD	8.36
SEM	1.06
Upper 95% Mean	15.96
Lower 95% Mean	11.72
N	62

As explained later, participants in the novice group were firefighters with less than 10 years' experience. Of those novices (*n* = 23), experience ranged from less than one year to nine years, with an average of 5.57 (*SD* = 2.69). The summary in Table 3 shows the mean and the upper and lower 95th confidence intervals for the mean. Figure 7 presents a histogram for years of experience in the novice group.

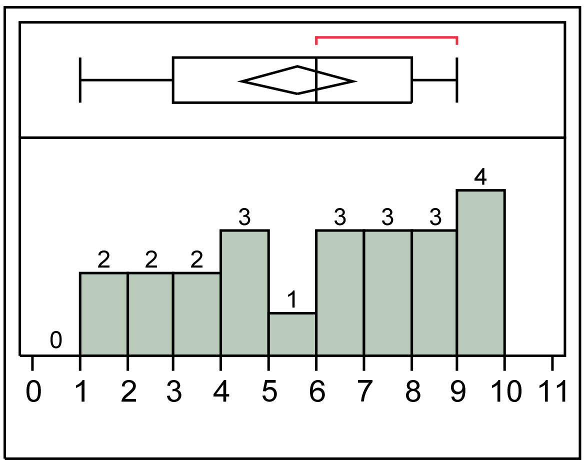


Figure 7: Novice Experience Distribution.

Table 3: Summary of Years of Experience for Novices

Mean	5.57
Std Dev	2.69
Std Err Mean	0.56
Upper 95% Mean	6.73
Lower 95% Mean	4.40
N	23

Subjects with 10 years or more experience are considered veterans. Of those veterans (*n* = 39), experienced ranged from 10 years (*n* = 4) to 35 years (*n* = 1), with an average of 18.72 (*SD* = 6.48). Table 4 provides a summary of the veteran group. Figure 8 displays a histogram for years of experience.

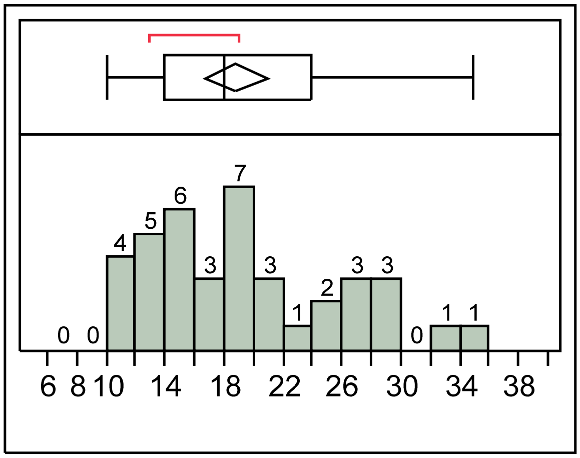


Figure 8: Veteran Experience Distribution.

Table 4: Summary of Years of Experience for Veterans

Mean	18.72
Std Dev	6.48
Std Err Mean	1.04
Upper 95% Mean	20.82
Lower 95% Mean	16.62
N	39

Experience with Fire Behavior

While years in service are previously discussed, experience in training and exposure to real life fire behavior is important. Nearly 63% (n = 39) of the participants reported experience as an on-scene incident commander (where incident command is their primary job responsibility). Their experience varied from 1 to 26 years. As can be seen in Figure 9, all (N = 62) of the participants reported some level of fire behavior training; more than half (n = 34) reported participating in semi-annual training sessions.

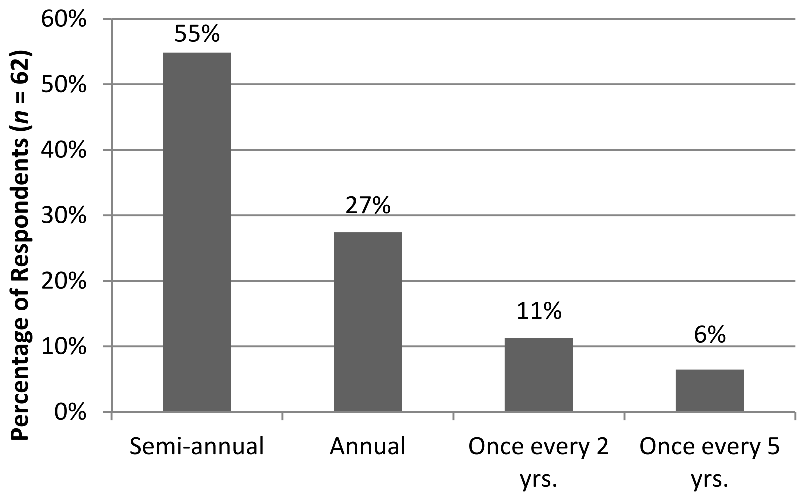


Figure 9: Distribution for Frequency of Fire Behavior Training.

Participants (*N* = 62) were asked to provide an estimation of the number of times they had been engaged in real life (not including training props) in each one of the following firefighting scenarios: a) pre-flashover[1], b) flashover c) rollover[2], d) pre-backdraft[3] and e) backdraft. Potential answers included *large number* (> 30 times), *many* (10 to 30), *several* (4 to 10), *few* (< 4), and *never*. Figure 10 presents distribution of frequency of engaging in real firefighting scenarios. Not all of the participants had experience with all six types of firefighting scenarios. Among those that had not encountered all of the scenarios, 73% (*n* = 45) had never encountered flashover and 84% (*n* = 52) had never encountered backdraft. Rollover was the most commonly-experienced event (*n* = 56) and pre-flashover was the second most frequently encountered (*n* = 51).

[1] Pre-flashover is indicative of the time and conditions preceding flashover.
[2] Rollover (also known as flameover) is "caused by the ignition of the unburned gases in the bottom of the upper gas layer and often precedes flashover" (National Fire Protection Agency, 2005, p. 31)
[3] Pre-Backdraft is indicative of the time and conditions preceding backdraft.

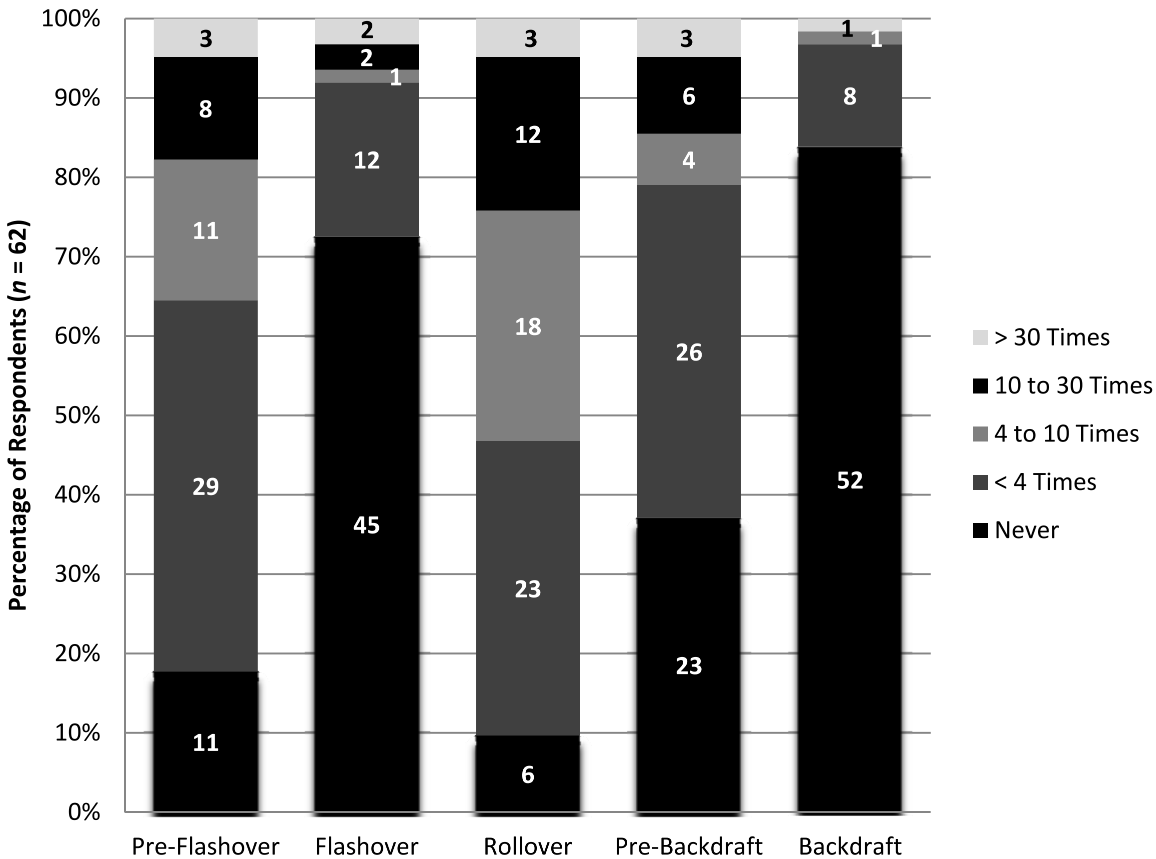


Figure 10: Experience with Real Firefighting Scenarios.

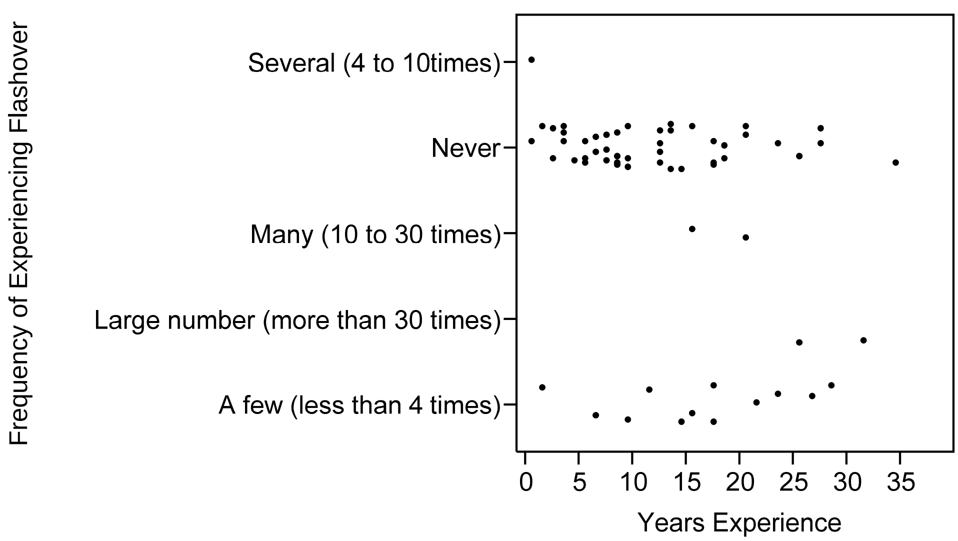


Figure 11: Experience with Flashover.

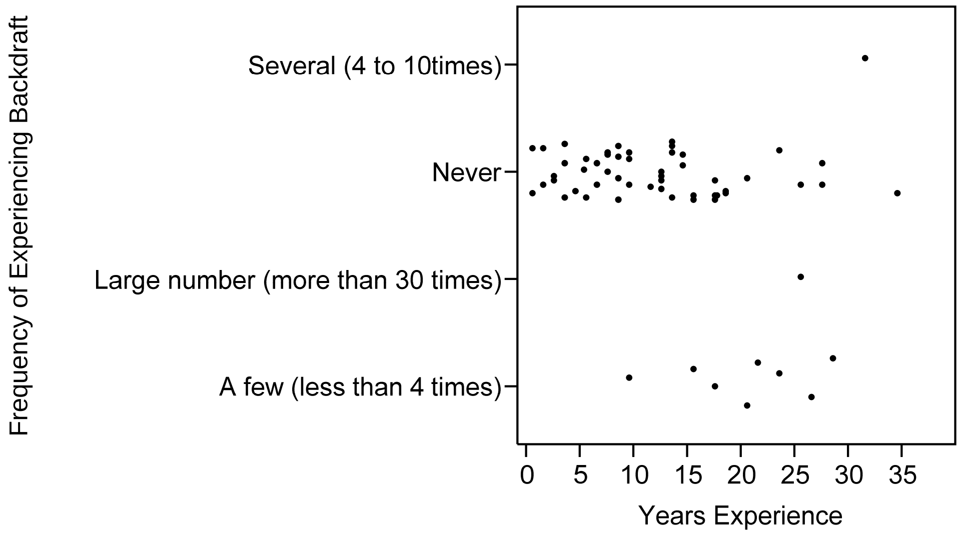


Figure 12: Experience with Backdraft.

As described previously, veterans were considered to be participants with a minimum of 10 years documented firefighting experience (*n* = 39). Likewise, participants with nine or less years were classified as novices (*n* = 23). Transitions from novice to veteran are not so much time-dependent as they are experience-dependent. Therefore justification for the 10 years as a cutoff experience for novices and veterans may also be documented on the participant's history with fire behavior. As can be seen in Figures 11 and 12, only three novice (~13%) participants had previously faced a flashover (as opposed to 14 veterans, 35.9%), while zero novice participants had previously faced a backdraft (10 veterans had experience with backdrafts, 25.6%). Still, it is very possible for novice firefighters to have flashover and/or backdraft experience, and veteran firefighters to have relatively little flashover or backdraft experience (see Figures 11 and 12). While it is not unreasonable to assume novice firefighters may adequately recognize signs of flashover and backdraft, a lack of significant real-life exposure to such extreme firefighting phenomena could lead one to make sub-optimal choices.

Ten years may appear to be an excessive experience level, but when considering the amount of information needed to obtain significant knowledge of fire behavior and the enormity of factors associated with this behavior and the appropriate response, ten years becomes more appropriate. Ericsson and Charness (1994) proposed that expertise can be gained only from performing a task for 4 hours/day, 6-7 days/week, for about 10 years! A secondary point of reasoning behind this cutoff level decision is based on the premise that on-the-job training is very common in the fire service field, with little formalized company officer development occurring at most departments. Thus, promotions to company officer are often sought after and achieved only by 'seasoned' veterans with vast experience and knowledge to draw from. It would not be uncommon to find many firefighters spending the first 7 to 10 years as the least senior firefighters (in their companies) still 'learning the ropes,' so to speak, while learning the nuisances of the job and preparing themselves for upcoming promotions to company officer. In fact, Hutton and Klein (1999) suggest that an "urban firefighter may gain a satisfactory level of expertise within 5 years on the job compared to a rural firefighter, who may take 10-15 years to achieve the same skill level" (p. 35).

CHAPTER 4: RESEARCH QUESTIONS AND HYPOTHESES

Research Questions

The study was guided by the following research questions:

1. What are the effects of tradeoff values on decision-making characteristics in firefighters?
2. What are the effects of time pressure on decision-making characteristics in firefighters?
3. What are the associations of physiological responses to stress with firefighter decision making?
4. What are the effects of experience on firefighter decision making?

Hypotheses

The following null hypotheses were tested in this study:

Experiment #1

Tradeoff

H1. Time to decision in the low tradeoff group is not significantly longer than time to decision in the high tradeoff group.

H2. The amount of information processed in the low tradeoff group is not significantly greater than the amount of information processed in the high tradeoff group.

H3. Information search patterns in the low tradeoff group are not significantly less alternative-based than these patterns in the high tradeoff group.

To test for stress, changes in heart rate and blood pressure were compared:

H4. Stress in the low tradeoff group is not significantly more challenge-related than stress in the high tradeoff group.

Experience

H5. There is no significant difference in the average time to decision between the novice and veteran experience group.

H6. The amount of information processed in the novice experience group is not significantly greater than the amount of information processed in the veteran experience group.

H7. Information search patterns in the novice experience group are not significantly less alternative-based than these patterns in the veteran experience group.

H8. Cardiovascular profiles in the novice group are not significantly different than cardiovascular profiles in the veteran group.

Tradeoff by Experience

H9. Time to decision is not significantly different by tradeoff and experience.

H10. Amount of information processed is not significantly different by tradeoff and experience.

H11. Information search patterns are not significantly different by tradeoff and experience.

H12. Stress is not significantly different by tradeoff and experience.

Experiment #2

Time Pressure

H13. Time to decision in the low time pressure group is not significantly longer than time to decision in the high time pressure group.

H14. The amount of information processed in the low time pressure group is not significantly greater than the amount of information processed in the high time pressure group.

H15. The information search patterns in the low time pressure group are not significantly more alternative-based than information search patterns in the high time pressure group.

H16. Stress in the low time pressure group is not significantly more challenge-related than stress in the high time pressure group.

Experience

H17. Time to decision in the novice experience group is not significantly longer than time to decision in the veteran experience group.

H18. The amount of information processed in the novice experience group is not significantly greater than the amount of information processed in the veteran experience group.

H19. The information search patterns in the novice experience group are not significantly less alternative-based than information search patterns in the veteran experience group.

H20. Stress in the novice experience group is not significantly more challenge-related than stress in the veteran experience group.

Time Pressure by Experience

H21. Time to decision is not significantly different by time pressure and experience.

H22. Amount of information processed is not significantly different by time pressure and experience.

H23. Information search patterns are not significantly different by time pressure and experience.

H24. Stress is not significantly different by time pressure and experience.

CHAPTER 5: RESULTS

Experiment 1: Tradeoff Level

Tradeoff difficulty is defined as the degree to which making an explicit tradeoff between two attributes generates threat or negative emotion (Luce, et al., 2001). Firefighters occasionally find themselves faced with decisions that cause extremely difficult value tradeoffs, and many of these decision dilemmas provide no safe options. For example, there may be a situation where if an incident commander immediately selects a safer alternative for subordinates, this may alternately increase the victims' risk. This would constitute a decision task with high tradeoffs. Tradeoff is considered cognitively difficult (Beattie & Barlas, 2001), and people often prefer to not directly confront a conflict, especially when trading off more of one valued attribute for less of another (Hogarth, 1987). Thus, the scenario in Experiment 1 established a challenging tradeoff difficulty for participants, specifically in the firefighting arena.

For comparing results in this experiment, all included analyses are examined for equal variance, utilizing Equation 6 as a criterion. Equal variance was confirmed throughout.

$$\frac{SD_{max}}{SD_{min}} \leq 2 \tag{6}$$

Where,

SD_{max} is the larger standard deviation among the two groups compared and

SD_{min} is the smaller standard deviation among the two groups compared.

Time to Decision by Tradeoff

Overall, across all participants (N = 62), the average time to decision was 203.35 seconds (SD = 88.64). It was anticipated that time to decision in the low tradeoff group would be longer, as the cues in the scene indicate a very low likelihood that victims are in the house. A single-tail pooled-variance t test was used to analyze for differences between the low tradeoff and the high tradeoff groups. The following hypotheses were employed to examine this difference:

$H1_o$: Time to decision in the low tradeoff group is not significantly longer than time to decision in the high tradeoff group.

$H1_a$: Time to decision in the low tradeoff group is significantly longer than time to decision in the high tradeoff group.

Table 5 provides details on time to decision for the low and the high tradeoff groups. The significance analysis yield $t(60) = 2.13$, $p = .0188$, with a medium effect size (Cohen's d = 0.54). As was expected, participants under low tradeoff took significantly longer to reach a decision; therefore the null hypothesis was rejected and the alternative hypothesis was accepted.

Table 5: Statistical Summary for Time to Decision by Tradeoff Level

Tradeoff	***n***	***M***	***SD***	***SE***	***t* ratio**	***p*-value**
Low	31	226.64	96.17	15.04	2.13	.0188*
High	31	180.07	74.87	15.71		

* $\alpha \leq .05$ for significance; ** $.05 < \alpha \leq .10$ for moderate significance

Information Processed by Tradeoff

To quantify the amount of information processed, the number of cells each participant reviewed was counted. Research suggests that a "key distinction" among decision tasks is whether decision makers explicitly ignore potentially relevant information (Payne, et al., 1988, p. 30). The measure used here will determine whether information processed is affected by tradeoff level. The results indicated that the total amount of information examined varied, from quite cursory (zero cells reviewed) to exhaustive (26 cells reviewed). Though the matrix only provided 16 different cells, if a multiple review of any cell occurred, each successive review was included in the count. The decision strategy is of importance in quantifying the information processes, as the total amount of processing for strategies such as EBA, LEX, and SAT is contingent upon the particular values of the alternatives and cutoffs.

Overall, across all participants (*N* = 62), the average amount of information processed was 6.61 cells (*SD* = 4.98). It was anticipated that the amount of information processed in the low tradeoff group would be greater, as the cues would provide participants indications that the potential for viable victim(s) in need of rescue is low. Thus, without the need for victim rescue, participants would allow themselves more thorough review of information before making a decision. A single-tail pooled-variance *t* test was used to analyze for significance between the low tradeoff and the high tradeoff groups. The following hypotheses were employed to examine this difference:

$H2_o$: The amount of information processed in the low tradeoff group is not significantly greater than the amount of information processed in the high tradeoff group.

$H2_a$: The amount of information processed in the low tradeoff group is significantly greater than the amount of information processed in the high tradeoff group.

Table 6 provides details on the information processed for the low and the high tradeoff groups. The significance analysis yield $t(60) = 1.88$, $p = .0329$, with a medium effect size (Cohen's $d = 0.48$). As was expected, participants under low tradeoff processed more information to reach a decision; therefore the null hypothesis was rejected and the alternative hypothesis was accepted.

Table 6: Statistical Summary for Information Processed by Tradeoff Level

Tradeoff	***n***	***M***	***SD***	***SE***	***t* ratio**	***p*-value**
Low	31	7.77	5.74	0.88	1.88	.0329*
High	31	5.45	3.83	0.88		

* $\alpha \leq .05$ for significance; ** $.05 < \alpha \leq .10$ for moderate significance

Information Search Patterns by Tradeoff

Two "pure" models of information acquisition patterns have been described in previous studies (e.g., Ford et al., 1989; Payne, et al., 1993). A pure alternative-based information search pattern is a process in which the decision-maker sequentially reviews all information for a given alternative across dimensions. In contrast, for a pure dimension-based information search pattern, the decision-maker focuses on a given dimension and reviews all the alternatives along this dimension. VirtuTrace™ records the sequence in which information is acquired. A Search Index (SI) (Billings & Scherer, 1988) quantified the search sequence as shown in Equation 5. SI ranges from -1 (purely dimensional-based strategy) to +1 (purely alternative-based strategy). A positive SI value implies an alternative-oriented process, and a negative value implies a dimension-oriented process.

Overall, across all participants (N = 62), there was an average SI of 0.09 (SD = 0.69). It was anticipated that the information search patterns in the low tradeoff group would be less alternative-based, as cues to an empty house may lead participants towards a less cognitively-demanding review processing. A single-tail pooled-variance t test was used to analyze for significance between the low tradeoff and the high tradeoff groups. The following hypotheses were employed to examine this difference:

$H3_o$: Information search patterns in the low tradeoff group are not significantly less alternative-based than these patterns in the high tradeoff group.

$H3_a$: Information search patterns in the low tradeoff group are significantly less alternative-based than these patterns in the high tradeoff group.

Table 7 provides details for the SI for the low and the high tradeoff groups. The significance analysis yield $t(60) = 2.44$, $p = .0089$, with a medium effect size (Cohen's d = 0.62). As was expected, participants in the low tradeoff scenario processed information in a more dimensionally-based mode than subjects in the high tradeoff scenario. This accounted for a negative SI; therefore the null hypothesis was rejected and the alternative was accepted.

Table 7: Statistical Summary for Information Search Patterns by Tradeoff Level

Tradeoff	*n*	*M*	*SD*	*SE*	*t* ratio	*p*-value
Low	31	-0.11	0.69	0.12	2.44	.0089*
High	31	0.30	0.63	0.12		

* α ≤ .05 for significance; ** .05< α ≤.10 for moderate significance

Decision Strategy by Tradeoff

Levin and Jasper (1995) found that "examining choice strategies can…be extremely important in understanding the process by which decision makers successively narrow to a final choice" (p. 5). However, in some cases no readily apparent decision strategy was utilized. In the case of a randomized decision strategy, it was assumed that the decision task did not necessitate a specific strategy for the individual. Payne, et al., (1993) describe this event as the use of "simple random choice rule" (p. 123). Thus, each case of randomized information processing was categorized as RAN (short for RAN*domized decision strategy*).

Two new decision strategies were identified during the analyses of the decision portraits in this study. A review of current literature failed to reveal indication for the presence of these strategies. These two strategies involved multiple heuristics similar to the poliheuristic strategy, as defined by Mintz (2004). The two strategies were titled diminished expectations (DE) and poliheuristic-to-diminished expectations (POLI2DE). A thorough review of these strategies is provided in the Discussion section on pages 121-123.

Figure 13 displays the distribution of decision strategies in Experiment 1 (N = 62) where a total of 38.7% (n = 24) of the participants utilized no specific decision strategy (RAN). The same percentage (38.7%; n = 12) of participants of the low tradeoff and the high tradeoff groups did not employ a specific decision strategy. A Pearson's chi-square analysis revealed no statistical significance in distribution of decision strategies by tradeoff, X^2 (8, N = 62) = 5.99, p = .6488. It should be noted that this test may not be reliable, as the average cell count was less than five.

However, participants were slightly more likely to choose SAT (n = 5, 16.1%) and RPD (n = 5, 16.1%) under high tradeoff than under low tradeoff (n = 3, 9.7%; n =3, 9.7%, respectively). Participants were 40% more likely to utilize the alternative-based decision strategy SAT, and 60% more likely to utilize RPD in the high tradeoff condition. Likewise, participants were 100% more likely to utilize the dimension-based decision strategies of WADD and LEX, and 67% more likely to utilize POLI in low tradeoff versus high tradeoff. DE was the second most frequent decision strategy under both low and high tradeoff.

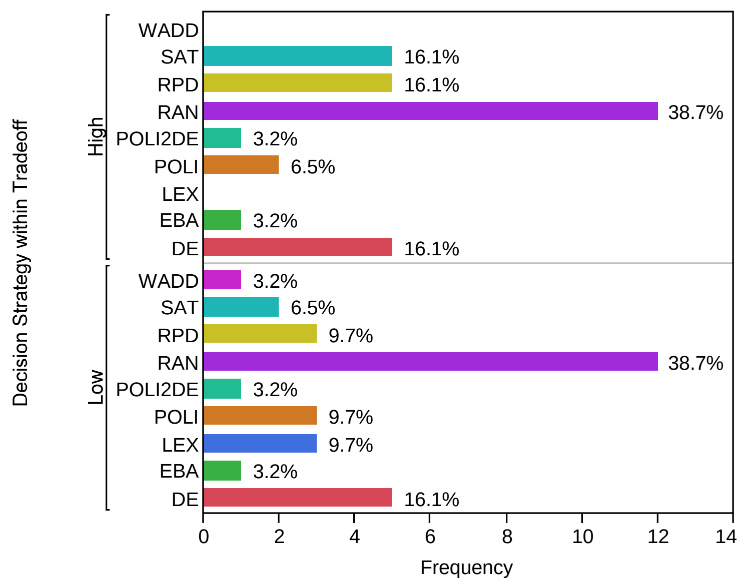


Figure 13: Decision Strategy by Tradeoff.
Note. DE = diminished expectations; EBA = elimination by aspect; LEX = lexicographic; POLI = poliheuristic; POLI2DE = poliheuristic to diminished expectations; RAN = random decision strategy; RPD = recognition primed decisions; SAT = satisficing; WADD = weighted additive.

Tables 8 and 9 display time to decision by decision strategy for the high and low tradeoff. Table 8 portrays that under high tradeoff, other than EBA, the three multi-stage decision processes (DE, POLI, and POLI2DE) provided the lowest time to decision. Table 9 portrays that under low tradeoff, participants utilizing more dimensionally-based decision strategies (EBA, POLI, LEX) had the lowest times to decision. It is important to note that the very low number of participants do not allow inferring typicality of these findings.

Table 8: Time to Decision by Decision Strategy (High Tradeoff)

Level	*n*	*M*	*SD*
RAN	12	189.36	70.55
SAT	5	252.08	102.51
RPD	5	146.85	41.83
DE	5	131.24	36.29
POLI	2	118.81	11.31
POLI2DE	1	246.51	
EBA	1	175.05	

Note. DE = diminished expectations; EBA = elimination by aspect; POLI = poliheuristic; POLI2DE = poliheuristic to diminished expectations; RAN = random decision strategy; RPD = recognition primed decisions; SAT = satisficing.

Table 9: Time to Decision by Decision Strategy (Low Tradeoff)

Strategy	*n*	*M*	*SD*
RAN	12	250.93	89.77
DE	5	231.41	49.98
RPD	3	218.58	111.12
LEX	3	168.58	49.96
POLI	3	129.75	62.26
SAT	2	318.84	197.09
WADD	1	363.91	
POLI2DE	1	223.62	
EBA	1	81.60	

Note. DE = diminished expectations; EBA = elimination by aspect; LEX = lexicographic; POLI = poliheuristic; POLI2DE = poliheuristic to diminished expectations; RAN = random decision strategy; RPD = recognition primed decisions; SAT = satisficing; WADD = weighted additive.

Final Choice by Tradeoff

Figure 14 portrays distribution of final choice based on high tradeoff (n =31) and low tradeoff (n = 31) groups. *Window* was the most frequent response for both high (n= 16, 51.6%) and low (n = 14, 45.2%) tradeoff groups (see pages 124-125 for a review and evaluation of the final choice options). A Pearson's chi-square analysis revealed no statistical significance between distribution of final choice by tradeoff, X^2 (3, N = 62) = 0.74, p = .8638. It should be noted that this test may not be reliable, as the average cell count was less than five.

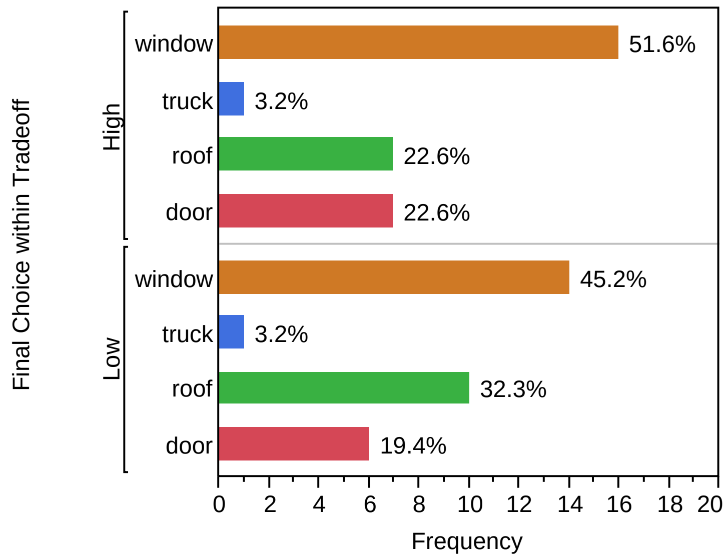


Figure 14: Final Choice by Tradeoff.

Physiological Response by Tradeoff

Blascovich and Tomaka (1996) presented a framework that differentiates challenge stress from threat-stress states. Challenge stress is a state in which an individual feels they have the appropriate cognitive capacity to deal with a situation, whereas in a threat-stress state perceives a lack of necessary mental resources (see also Frankenhaeuser, 1986; Henry, 1980). Mendes et al. (2007) showed that these two stress states have different cardiovascular signatures. Challenge-related stress results in an increased cardiac output and a reduction in the total peripheral resistance, to allow increased blood volume to the periphery and increased rate of blood flow to the brain and muscles. This would be characterized by an increase in heart rate (HR), but a decreasing blood pressure (BP). In contrast, a threat state presents a cardiovascular profile with decreased cardiac output and reduced efficiency and increased vasculature resistance. Thus, threat-related stress would be characterized by an increase in BP, with either a stable or decreasing HR.

Overall, physiological responses were obtained from 61 participants. Changes in HR and BP were calculated as provided in Equations 1 through 4. Due to equipment difficulties, one participant's results were not included throughout all the physiological data.

It was anticipated that under low tradeoff, the results from the physiological data would show responses more typical of challenge related stress (increase in heart rate, but a stable or decreasing blood pressure). A single-tail pooled-variance *t* test was used to analyze for significance in normalized HR and BP between the low tradeoff and the high tradeoff groups. The following hypotheses were employed to examine this difference:

$H4_o$: Stress in the low tradeoff group is not significantly more challenge-related than stress in the high tradeoff group.

$H4_a$: Stress in the low tradeoff group is significantly more challenge-related than stress in the high tradeoff group.

Table 10 provides details on the normalized maximum change in HR for the low and the high tradeoff groups. The significance analysis for the normalized maximum change in HR yield $t(59) = 1.01$, $p = .1572$.

Table 10: Statistical Summary for Normalized Maximum HR by Tradeoff

Tradeoff	***n***	***M***	***SD***	***SE***	***t* ratio**	***p*-value**
Low	31	53.87	43.90	8.65	1.01	.1572
High	30	66.39	52.25	8.80		

* α ≤ .05 for significance; ** .05< α ≤.10 for moderate significance

To assure that the opposite effect did not occur (e.g., threat-related stress), the significance of the decrease in HR was tested. Table 11 shows that the normalized minimum HR yield $t(59) = 0.68$, $p = .2499$.

Table 11: Statistical Summary for Normalized Minimum HR by Tradeoff

Tradeoff	***n***	***M***	***SD***	***SE***	***t* ratio**	***p*-value**
Low	31	-16.03	16.76	3.31	0.68	.2499
High	30	-19.23	19.99	3.36		

* α ≤ .05 for significance; ** .05< α ≤.10 for moderate significance

Table 12 provides details on the normalized maximum BP for the low and the high tradeoff groups. The significance analysis for the normalized maximum change in BP yield $t(59) = 0.49$, $p = .3143$.

Table 12: Statistical Summary for Normalized Maximum BP by Tradeoff

Tradeoff	***n***	***M***	***SD***	***SE***	***t* ratio**	***p*-value**
Low	31	51.01	21.45	5.24	0.49	.3143
High	30	54.65	35.42	5.32		

* α ≤ .05 for significance; ** .05< α ≤.10 for moderate significance

To assure that the opposite effect did not occur (e.g., threat-related stress), the significance of the decrease in BP was tested. Table 13 shows that the normalized minimum BP yield $t(59) = 1.16$, $p = .1256$.

Table 13: Statistical Summary for Normalized Minimum BP by Tradeoff

Tradeoff	***n***	***M***	***SD***	***SE***	***t* ratio**	***p*-value**
Low	31	20.24	27.12	5.63	1.16	.1256
High	30	29.54	35.15	5.72		

* α ≤ .05 for significance; ** .05< α ≤.10 for moderate significance

To test for stress, changes in heart rate and blood pressure were compared. The data shows that stress in the low tradeoff group was not significantly more challenge-related than stress in the high tradeoff group, therefore the data failed to reject the null hypothesis.

Experiment 1: Experience

Time to Decision by Experience

Overall, across all novice and veteran participants ($N = 62$), the average time to decision was 203.35 seconds ($SD = 88.64$). The literature suggests that time to decision in the novice group will be longer, as veterans are expected to make more expedient decisions (Kobus, et al., 2000; Warwick, et al., 2001). A two-tail pooled-variance *t* test was used to analyze for significance between the novice and veteran groups. The following hypotheses were employed to examine this difference:

$H5_o$: There is no significant difference in the average time to decision between the novice and veteran experience group.

$H5_a$: There is a significant difference in the average time to decision between the novice and veteran experience group.

Table 14 provides details on the information processed for the novice and veteran experience groups. The significance analysis yield $t(60) = 3.02$, $p = .0874$, indicating that the time to decision of the veteran experience group was moderately longer than the time to decision in the novice group, with a medium effect size (Cohen's $d = 0.47$). Contrary to the literature, it was not the novices that took longer to make a decision, but rather the veteran participants. Thus, the null hypothesis was rejected.

Table 14: Statistical Summary for Time to Decision by Experience

Experience	***n***	***M***	***SD***	***SE***	***t* ratio**	***p*-value**
Novice	23	178.29	78.17	17.57	1.74	.0874**
Veteran	39	218.13	92.03	13.44		

* α ≤ .05 for significance; ** .05< α ≤.10 for moderate significance

Information Processed by Experience

Overall, across all novice and veteran participants ($N = 62$), the average amount of information processed was 6.61 cells ($SD = 4.98$). It was anticipated that the amount of information processed in the novice experience group would be greater, as veteran's abilities to recognize the situation, either from prior knowledge or expertise, would lead to extremely expedient decision-making (Warwick, et al., 2001). A single-tail pooled-variance *t* test was used to analyze for significance between novice and veteran experience groups. The following hypotheses were employed to examine this difference:

$H6_o$: The amount of information processed in the novice experience group is not significantly greater than information processed in the veteran experience group.

$H6_a$: The amount of information processed in the novice experience group is significantly greater than the amount of information processed in the veteran experience group.

Table 15 provides details on the information processed for the novice and veteran experience groups. The significance analysis yield $t(60) = 0.74$, $p = .2305$, indicating that the amount of information processed among the novice group was not greater than the amount of information processed in the veteran group; thus, the analysis failed to reject the null hypothesis.

Table 15: Statistical Summary for Information Processed by Experience

Experience	***n***	***M***	***SD***	***SE***	***t* ratio**	***p*-value**
Novice	23	6.00	5.23	1.04	0.74	.2305
Veteran	39	6.97	4.85	0.80		

* α ≤ .05 for significance; ** .05< α ≤.10 for moderate significance

Information Search Patterns by Experience

As described earlier, the search index (SI) was used to identify information search patterns. Overall, across all novice and veteran participants ($N = 62$), the average SI was 0.09 ($SD = 0.69$). It was anticipated that SI (Billings & Scherer, 1988) in the novice group would be lower, as lack of expertise may lead participants towards a less cognitively-demanding (dimension-based) review patterns. A single-tail pooled-variance *t* test was used to analyze for significance between the novice and veteran experience groups. The following hypotheses were employed to examine this difference:

$H7_o$: Information search patterns in the novice experience group are not significantly less alternative-based than these patterns in the veteran experience group.

$H7_a$: Information search patterns in the novice experience group are significantly less alternative-based than these patterns in the veteran experience group.

Table 16 provides details on SI for the novice and the veteran experience groups. The significance analysis yield $t(60) = 2.53$, $p = .0071$, with a medium-large effect size (Cohen's $d = 0.66$), indicating that patterns in the novice group were significantly less alternative-based than the patterns in the veteran group. As was expected, novice participants processed information in a more dimensionally-based mode to make a decision than did veterans participants; therefore the null hypothesis was rejected.

Table 16: Statistical Summary for Search Indices by Experience

Experience	***n***	***M***	***SD***	***SE***	***t* ratio**	***p*-value**
Novice	23	-0.18	0.69	0.14	2.53	.0071*
Veteran	39	0.26	0.64	0.11		

* $\alpha \le .05$ for significance; ** $.05 < \alpha \le .10$ for moderate significance

Decision Strategy by Experience

Figure 15 displays decision strategy by experience level (veterans $n = 39$, novices $n = 23$). A Pearson's chi-square analysis revealed no statistically significant difference in distribution of decision strategy by experience, X^2 (8, $N = 62$) = 6.69, $p = .5701$. It should be noted that this test may not be reliable, as the average cell count was less than five.

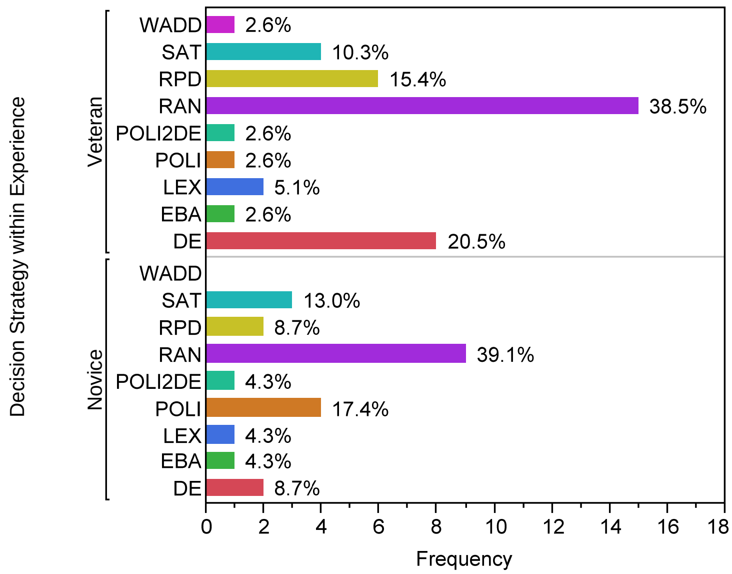


Figure 15: Decision Strategy by Experience.
Note. DE = diminished expectations; EBA = elimination by aspect; LEX = lexicographic; POLI = poliheuristic; POLI2DE = poliheuristic to diminished expectations; RAN = random decision strategy; RPD = recognition primed decisions; SAT = satisficing; WADD = weighted additive.

Final Choice by Experience

Figure 16 portrays the frequency of final choice by experience level. Among veterans, *window* (n = 22) was selected at nearly four times the rate of *door* (n = 6). Veteran participants (n =39) chose *window* more than three times the rate of novices (n = 23). A Pearson's chi-square analysis revealed a moderately significant difference in the frequencies of the final choice selections and experience, X^2 (3, N = 62) = 7.75, p = .0573, suggesting that veterans may be more likely to select *window* as their final choice. However, as previously noted, this test may not be reliable, as the average cell count was less than five.

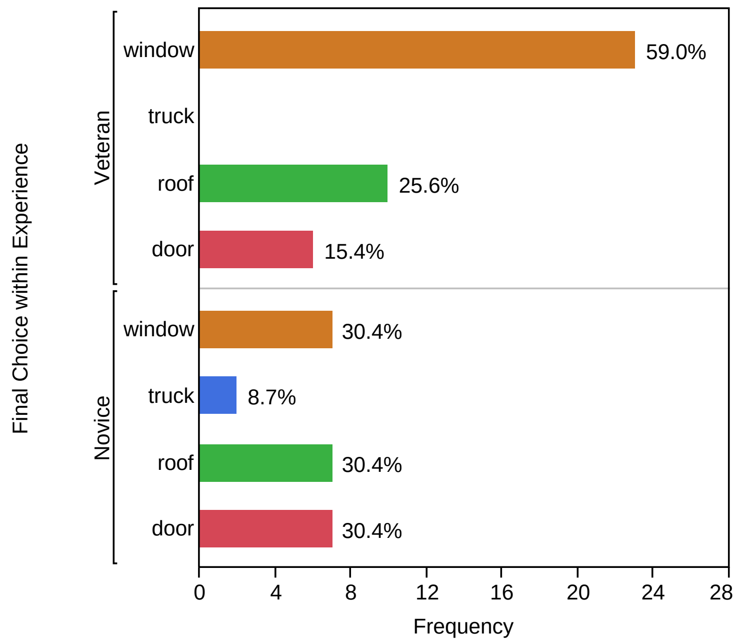


Figure 16: Final Choice by Experience.

Physiological Response by Experience

The expectation was that veterans would demonstrate a cardiovascular profile that is more typical to challenge-related stress (lower BP, and higher HR) than novices when stressors are present. A two-tailed *t* test was used to analyze for significance in normalized HR and BP between the novice and the veteran groups. The following hypotheses were employed to examine this difference:

$H8_o$: Cardiovascular profiles in the novice group are not significantly different than cardiovascular profiles in the veteran group.

$H8_a$: Cardiovascular profiles in the novice group are significantly different than cardiovascular profiles in the veteran group.

Table 17 provides details on the normalized maximum change in HR for the novice and veteran groups. The significance analysis for the normalized maximum change in HR yield $t(59) = 0.21$, $p = .8354$.

Table 17: Statistical Summary for Normalized Maximum HR by Experience

Experience	*n*	*M*	*SD*	*SE*	*t* ratio	*p*-value
Novice	23	61.70	47.10	10.13	0.21	.8354
Veteran	38	59.02	49.45	7.88		

* $\alpha \leq .05$ for significance; ** $.05 < \alpha \leq .10$ for moderate significance

To assure that the opposite effect did not occur (e.g., threat-related stress), the significance of the decrease in HR was tested. Table 18 shows that the normalized minimum HR yield $t(59) = 0.59$, $p = .5542$.

Table 18: Statistical Summary for Normalized Minimum HR by Experience

Experience	*n*	*M*	*SD*	*SE*	*t* ratio	*p*-value
Novice	23	-15.80	15.81	3.84	0.59	.5542
Veteran	38	-18.70	19.83	2.99		

* $\alpha \leq .05$ for significance; ** $.05 < \alpha \leq .10$ for moderate significance

Table 19 provides details on the normalized maximum BP for the novice and veteran groups. The significance analysis for the normalized maximum change in BP yield $t(59) = 2.18$, $p = .0334$, with a medium-large effect size (Cohen's $d = 0.63$).

Table 19: Statistical Summary for Normalized Maximum BP by Experience

Experience	*n*	*M*	*SD*	*SE*	*t* ratio	*p*-value
Novice	23	42.73	12.90	5.86	2.18	.0334*
Veteran	38	58.90	34.08	4.56		

* $\alpha \leq .05$ for significance; ** $.05 < \alpha \leq .10$ for moderate significance

To assure that the opposite effect did not occur (e.g., threat-related stress), the significance of the decrease in BP was tested. Table 20 shows that the normalized minimum BP yield $t(59) = 0.93$, $p = .3574$.

Table 20: Statistical Summary for Normalized Minimum BP by Experience

Experience	*n*	*M*	*SD*	*SE*	*t* ratio	*p*-value
Novice	23	20.01	17.38	6.56	0.93	.3574
Veteran	38	27.72	37.39	5.10		

* $\alpha \leq .05$ for significance; ** $.05 < \alpha \leq .10$ for moderate significance

As can be seen in Table 19, novice participants demonstrated a cardiovascular profile significantly different from the veterans. The higher normalized maximum blood pressure suggests a cardiovascular profile for veterans more typical of threat-related stress than that of the novices. Therefore the null hypothesis was rejected and the alternative hypothesis was accepted.

Experiment 1: Tradeoff by Experience

Time to Decision by Tradeoff and Experience

Overall, across all novice and veteran participants in low tradeoff (*n* = 31), the average time to decision was 226.64 seconds (*SD* = 96.17), and in high tradeoff (*n* = 31) the average time to decision was 180.07 seconds (*SD* = 74.87). Overall, for novice participants in both high and low tradeoff (*n* = 23), the average time to decision was 178.29 seconds (*SD* = 78.17), whereas for veteran participants in both high and low tradeoff (*n* = 39), the average time to decision was 218.13 seconds (*SD* = 92.03).

It was anticipated that time to decision in novice participants, under low tradeoff, would be longest, as the research suggests that veterans typically make more expedient decisions and cues in the scene indicated a very low likelihood that victims are in the house. To determine level of interaction of time to decision based on experience and tradeoff, the tradeoff and experience variables were included in a two-way analysis of variance (ANOVA). The following hypotheses were employed to examine the effect of these relationships on time to decision:

$H9_o$: Time to decision is not significantly different by tradeoff and experience.

$H9_a$: Time to decision is significantly different by tradeoff and experience.

The main effects model resulted in *F*(3, 58) = 3.34, *p* = .0254. Under this model, both tradeoff, *F*(1, 58) = 5.08, *p* = .0281, and experience, *F*(*1*, 58) = 4.08, *p* = .0371, were found to be statistically significant. However, there was no significance in the time to decision when analyzing for an interaction of tradeoff and experience, *F*(*1*, 58) = 0.3967, *p* = .5313.

Table 21 shows further analysis which revealed that time to decision by veterans under low tradeoff (*LSM* = 254.69) to be statistically significant, *t*(58) = 2.05, *p* = .0449, compared to all other groups. It was not the novice group that took longer to make a decision, but rather the veteran participants. However, the results do show that under tradeoff and experience, time to decision is significantly different; therefore the null hypothesis was rejected and the alternative hypothesis was accepted.

Table 21: LS Means Difference Table for Time to Decision by Tradeoff and Experience

Level			**Least Sq Mean**
Low Tradeoff, Veteran	A		254.69
Low Tradeoff, Novice		B	192.57
High Tradeoff, Veteran		B	189.89
High Tradeoff, Novice		B	156.09

Note: Levels not connected by same letter are significantly different.

Information Processed by Tradeoff and Experience

Overall, across all novice and veteran participants in low tradeoff (*n* = 31), the average amount of information processed was 7.77 cells (*SD* = 5.74), and in high tradeoff (*n* = 31) the average amount of information processed was 5.45 cells (*SD* = 3.83). Overall, for novice participants in both low and high tradeoff (*n* = 23), the average amount of information processed was 6.00 cells (*SD* = 5.23), whereas for veteran participants in both low and high tradeoff (*n* = 39), the average information processed was 6.97 cells (*SD* = 4.85).

It was anticipated that the amount of information processed in the novice group under low tradeoff would be greatest, for two reasons. Veteran's abilities to perform situation recognition either from prior knowledge or expertise should lead to extremely expedient decision-making (Warwick, et al., 2001). Also, under low tradeoff condition, cues should provide participants indications that the potential for viable victim(s) in need of rescue is low. Thus, without the need for victim rescue, participants would not feel urged to make a decision.

To determine level of interaction of information processed based on experience and tradeoff, both these variables were included in a two-way analysis of variance (ANOVA). The following hypotheses were employed to examine this difference:

$H10_o$: Amount of information processed is not significantly different by tradeoff and experience.

$H10_a$: Amount of information processed is significantly different by tradeoff and experience.

The result for the main effects model was $F(3, 58) = 1.70$, $p = .1767$. Under this model, tradeoff, $F(1, 58) = 4.52$, $p = .0377$, was significant, while experience, $F(1, 58) = 1.30$, $p = .2587$, was found to be insignificant. There was also no significance in the information processed when analyzing for an interaction of tradeoff and experience, $F(1, 58) = 0.44$, $p = .5121$.

Table 22 shows further details which revealed that information processed by veterans under low tradeoff (*LSM* = 8.06) to be statistically significant, $t(58) = 2.12$, $p = .0381$, from novices under high tradeoff (*LSM* = 3.78). It was not the novice group, under low tradeoff condition that processed larger amount of information en route to making a decision, but rather the veteran participants. However, the amount of information processed under tradeoff by experience is significantly different; therefore, the null hypothesis was rejected and the alternative hypothesis was accepted.

Table 22: LS Means Difference Table for Information Processed by Tradeoff and Experience

Level			Least Sq Mean
Low Tradeoff, Veteran	A		8.0588235
Low Tradeoff, Novice	A	B	7.4285714
High Tradeoff, Veteran	A	B	6.1363636
High Tradeoff, Novice		B	3.7777778

Note: Levels not connected by same letter are significantly different.

Information Search Patterns by Tradeoff and Experience

Overall, across all novice and veteran participants in low tradeoff (n = 31) the average SI was -0.11 (SD = 0.69), while in the high tradeoff (n = 31), the average SI was 0.30 (SD = 0.63). Across all novice participants in both low and high tradeoff (n = 23), the average SI was -0.18 (SD = 0.69), whereas for all veteran participants (n = 39), the average SI was 0.26 (SD = 0.64). It was anticipated that the information search patterns in the novice group under low tradeoff would be least alternative-based for two reasons. A lack of expertise may lead participants towards a less cognitively-demanding, dimension-based review mode (Payne, et al., 1993), and in low tradeoff, cues to an empty house may lead participants towards the more cognitively-easy dimension-based review method.

To determine level of interaction of information search patterns based on experience and tradeoff, both these variables were included in a two-way analysis of variance (ANOVA). The following hypotheses were employed to examine this difference:

$H11_o$: Information search patterns are not significantly different by tradeoff and experience.

$H11_a$: Information search patterns are significantly different by tradeoff and experience.

The result for the main effects model was $F(3, 58) = 3.73$, $p = .0161$. Under this model both tradeoff, $F(1, 58) = 4.48$, $p = .0386$, and experience, $F(1, 58) = 4.62$, $p = .0357$, were found to be significant. However, there is no significance in the information search patterns when analyzing for an interaction of tradeoff and experience, $F(1, 58) = 0.1324$, $p = .7173$.

Table 23 shows further details which revealed that information search patterns by veterans under high tradeoff (*LSM* = 0.39) to be significantly different, $t(58) = 3.34$, $p = .0015$, from novices under low tradeoff (*LSM* = -0.35). Thus, as expected, novices under low tradeoff were the least alternative-based in their information search patterns. Therefore, the null hypothesis was rejected and the alternative hypothesis was accepted.

Table 23: LS Means Difference Table for Information Search Patterns by Tradeoff and Experience

Level			Least Sq Mean
High Tradeoff, Veteran	A		0.39
Low Tradeoff, Veteran	A	B	0.09
High Tradeoff, Novice	A	B	0.08
Low Tradeoff, Novice		B	-0.35

Note: Levels not connected by same letter are significantly different.

Decision Strategy by Tradeoff and Experience

When analyzing decision strategy grouped by tradeoff and experience, there were four groups: 1) veteran in the low tradeoff condition (*n* =17); 2) novice in the low tradeoff condition (*n* = 14); 3) veteran in the high tradeoff condition (*n* = 22); and 4) novice in the high tradeoff condition (*n* =9). As can be seen from Figure 17, RAN was most prevalent among veterans in high tradeoff. DE was more predominant among veterans, especially when under high tradeoff. However, a series of Pearson’s chi-square analyses revealed no statistically significant relationship between decision strategies distribution and the interaction of tradeoff and experience, $X^2(16, N = 62) = 15.04$, $p = .5218$. It should be noted that these tests may not be reliable, as the average cell count was less than five.

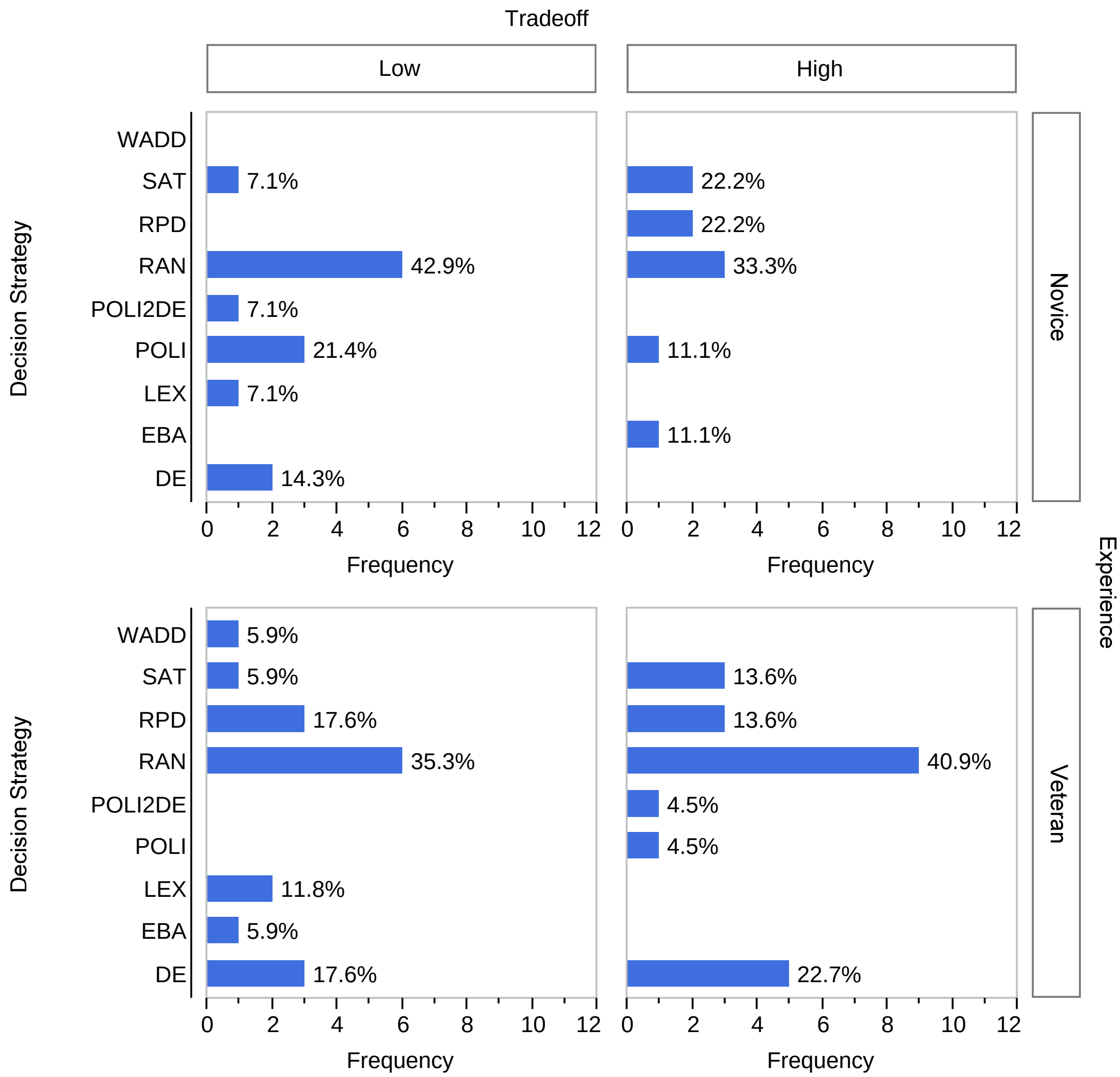


Figure 17: Decision Strategy by Tradeoff and Experience.
Note. DE = diminished expectations; EBA = elimination by aspect; LEX = lexicographic; POLI = poliheuristic; POLI2DE = poliheuristic to diminished expectations; RAN = random decision strategy; RPD = recognition primed decisions; SAT = satisficing; WADD = weighted additive.

Final Choice by Tradeoff and Experience

Similarly to decision strategy, analyzing for final choice is grouped by tradeoff and experience. As can be seen in Figure 18, *window* was most prevalent among veterans in high tradeoff. *Door* was most predominant among novices, especially when under high tradeoff. A series of Pearson's chi-square analyses revealed no statistically significant relationship between final choice selection and the interaction of tradeoff and experience,

X^2 (6, N = 62) = 9.03, p = .1719. However, the effect likelihood model showed a statistical significance for final choice and experience, X^2 (3, N = 62) = 8.29, p = .0404, suggesting that significantly more veterans (n = 23) than novices (n = 7) selected window as their final choice. It should be noted that these tests may not be reliable, as the average cell count was less than five.

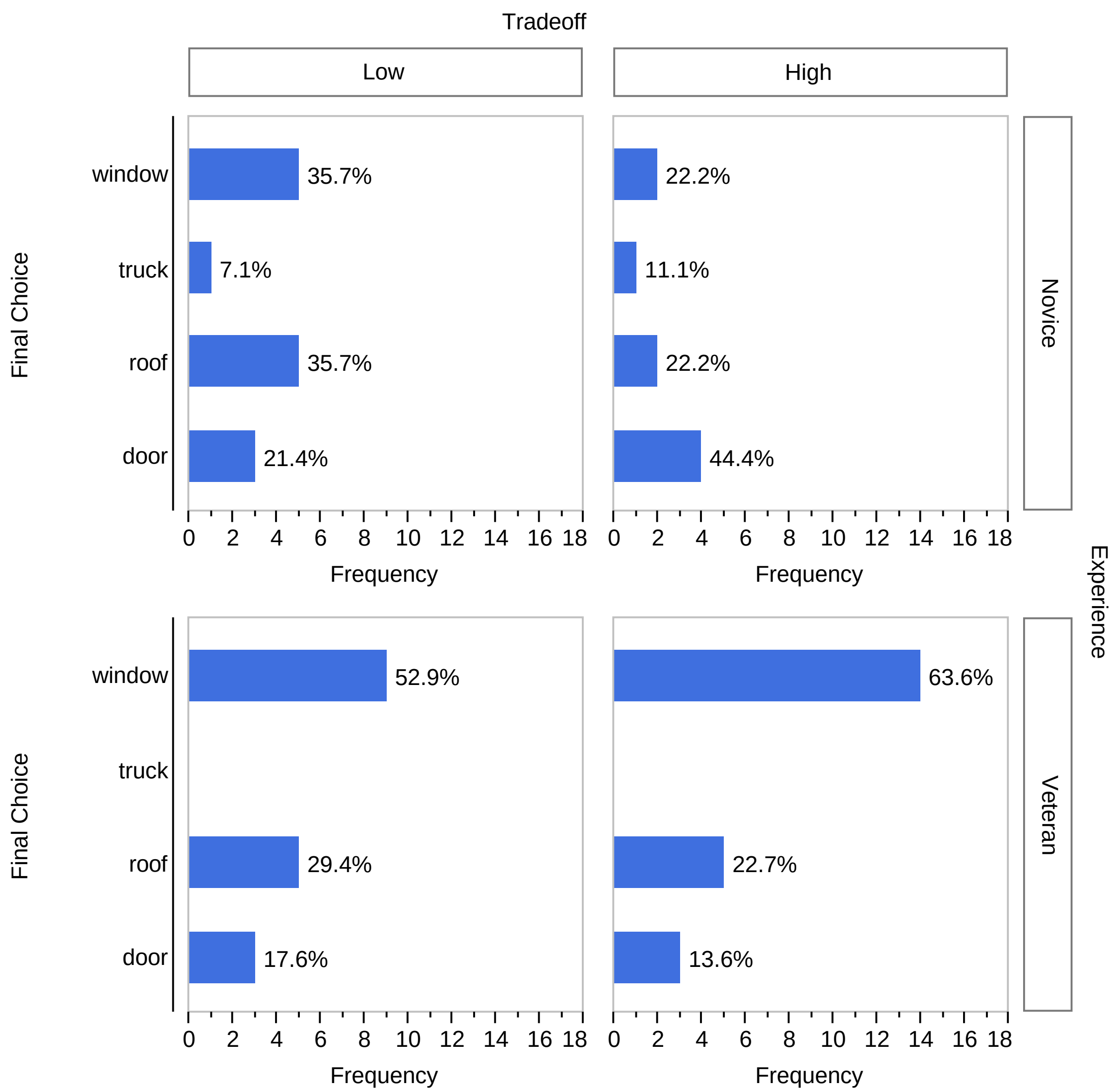


Figure 18: Final Choice by Tradeoff and Experience.

Table 24 shows distribution of final choice by tradeoff and decision strategy. From the totals, it can be seen that level of tradeoff had insignificant impact on the final choice. Participants utilizing RAN had a higher likelihood of selecting *door* as a final choice, than those utilizing other decision strategies. Under high tradeoff, both *roof* and *window* increased in frequency as selections by participants utilizing (primarily) alternative-based decision strategies of SAT and RPD.

Table 24: Final Choice by Decision Strategy and Tradeoff

	Door		Roof		Truck		Window	
Tradeoff	High	Low	High	Low	High	Low	High	Low
DE	1	0	3	0	0	0	4	2
EBA	0	0	0	0	1	0	0	1
LEX	0	3	0	0	0	0	0	0
MCD	0	0	0	0	0	0	0	0
POLI	0	0	1	2	0	0	1	1
POLI2DE	1	0	0	1	0	0	0	0
RAN	4	3	3	1	0	0	5	8
RPD	1	0	1	2	0	0	3	1
SAT	0	0	2	1	0	1	3	0
WADD	0	0	0	0	0	0	0	1
Total	7	6	10	7	1	1	16	14

Note. High = high tradeoff; Low = low tradeoff; DE = diminished expectations; EBA = elimination by aspect; LEX = lexicographic; MCD = majority of conforming decisions; RAN = random decision strategy; POLI = poliheuristic; POLI2DE = poliheuristic to diminished expectations; RPD = recognition primed decisions; SAT = satisficing; WADD = weighted additive.

Final Choice under Low Tradeoff

Table 25 displays the overall final choice based on experience for participants under the low tradeoff scenario.

Table 25: Final Choice by Experience (Low Tradeoff)

Experience	***Roof***	***Door***	***Truck***	***Window***
Novice	5 (36%)	3 (21%)	1 (7%)	5(36%)
Veteran	5 (29%)	3 (18%)	0	9 (53%)

Final Choice under High Tradeoff

Table 26 displays the overall final choice based on experience for participants under the high tradeoff scenario.

Table 26: Final Choice by Experience (High Tradeoff)

Experience	***Roof***	***Door***	***Truck***	***Window***
Novice	2 (22%)	4 (45%)	1 (11%)	2(22%)
Veteran	5 (23%)	3 (14%)	0	14 (63%)

Physiological Response by Tradeoff and Experience

To determine whether tradeoff conditions and experience have statistically significant main effects on physiological response, two-way ANOVA were conducted on changes of the normalized minimum and maximum HR and BP. The following hypotheses were employed for physiological response by tradeoff condition and experience level:

$H12_o$: Stress is not significantly different by tradeoff and experience.

$H12_a$: Stress is significantly different by tradeoff and experience.

Table 27 provides summary of changes in normalized minimum HR by tradeoff and experience. Table 28 provides the results of an ANOVA on the interactions among tradeoff condition and experience level for changes in normalized minimum HR. Similarly:

- Tables 29 and 30 provide details for changes in normalized maximum HR.
- Tables 31 and 32 provide details for changes in normalized minimum BP.
- Tables 33 and 34 provide details for changes in normalized maximum BP.

Table 27: Statistical Summary for Normalized Minimum HR by Tradeoff and Experience

Experience	Tradeoff	*n*	Mean [%]	*SD*	*SE*
Novice	High	9	-18.0	14.17	4.72
Novice	Low	14	-14.4	17.1	4.58
Veteran	High	22	-15.2	18.0	3.83
Veteran	Low	16	-23.5	21.8	5.46

Table 28: Interaction of Normalized Minimum HR by Tradeoff and Experience

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
NOV-Low	VET-Low	9.11	6.74	-4.39	22.61	.1819
VET-High	VET-Low	8.27	6.05	-3.85	20.39	.1773
NOV-High	VET-Low	5.47	7.68	-9.91	20.84	.4793
NOV-Low	NOV-High	3.64	7.87	-12.12	19.41	.6451
VET-High	NOV-High	2.80	7.29	-11.79	17.39	.7022
NOV-Low	VET-High	0.84	6.29	-11.77	13.45	.8940

* α ≤ .05 for significance; ** .05< α ≤.10 for moderate significance

Table 29: Statistical Summary for Normalized Maximum HR by Tradeoff and Experience

Experience	Tradeoff	*n*	Mean [%]	*SD*	*SE*
Novice	High	9	50.8	35.1	11.69
Novice	Low	14	68.7	53.5	14.30
Veteran	High	22	55.1	47.7	10.18
Veteran	Low	16	64.4	52.8	13.20

Table 30: Interaction of Normalized Maximum HR by Tradeoff and Experience

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
NOV-Low	NOV-High	17.93	20.93	-23.97	59.84	.3950
NOV-Low	VET-High	13.58	16.74	-19.95	47.11	.4206
VET-Low	NOV-High	13.58	20.41	-27.29	54.44	.5085
VET-Low	VET-High	9.23	16.09	-22.99	41.45	.5685
NOV-Low	VET-Low	4.35	17.92	-31.54	40.24	.8090
VET-High	NOV-High	4.35	19.38	-34.46	43.15	.8233

* α ≤ .05 for significance; ** .05< α ≤.10 for moderate significance

Table 31: Statistical Summary for Normalized Minimum BP by Tradeoff and Experience

Experience	**Tradeoff**	***n***	**Mean [%]**	***SD***	***SE***
Novice	High	9	16.9	17.4	5.78
Novice	Low	14	22.0	17.7	4.74
Veteran	High	22	21.6	30.5	6.50
Veteran	Low	16	36.1	44.9	11.23

Table 32: Interaction of Normalized Minimum BP by Tradeoff and Experience

Level	**- Level**	**Difference**	**Std Err Dif**	**Lower CL**	**Upper CL**	**p-Value**
VET-Low	NOV-High	19.24	13.09	-6.98	45.46	.1472
VET-Low	VET-High	14.49	10.32	-6.19	35.16	.1660
VET-Low	NOV-Low	14.08	11.49	-8.95	37.11	.2259
NOV-Low	NOV-High	5.16	13.42	-21.72	32.04	.7021
VET-High	NOV-High	4.75	12.43	-20.15	29.65	.7038
NOV-Low	VET-High	0.41	10.74	-21.10	21.92	.9697

* $\alpha \leq .05$ for significance; ** $.05 < \alpha \leq .10$ for moderate significance

Table 33: Statistical Summary for Normalized Maximum BP by Tradeoff and Experience

Experience	**Tradeoff**	***n***	**Mean [%]**	***SD***	***SE***
Novice	High	9	42.9	9.9	3.29
Novice	Low	14	42.6	14.9	3.98
Veteran	High	22	54.4	24.1	5.14
Veteran	Low	16	65.2	44.5	11.13

Table 34: Interaction of Normalized Maximum BP by Tradeoff and Experience

Level	**- Level**	**Difference**	**Std Err Dif**	**Lower CL**	**Upper CL**	**p-Value**
VET-Low	NOV-Low	22.53	10.35	1.81	43.24	.0336*
VET-Low	NOV-High	22.29	11.78	-1.29	45.88	.0635**
VET-High	NOV-Low	11.71	9.66	-7.64	31.07	.2305
VET-High	NOV-High	11.48	11.19	-10.92	33.88	.3092
VET-Low	VET-High	10.81	9.29	-7.79	29.41	.2492
NOV-High	NOV-Low	0.26	12.08	-23.95	24.42	.9845

* $\alpha \leq .05$ for significance; ** $.05 < \alpha \leq .10$ for moderate significance

A review of data in Tables 27 through 34 reveals that changes in normalized HR were not significant throughout; changes in normalized minimum BP were not significant as well.

Table 34, however, shows significant interaction between veterans and novices in the low tradeoff condition (p = .0336), where, veterans had a significantly higher increase in normalized maximum BP (M = 65.2, SD = 44.5) than novices (M = 42.6, SD = 14.9), potentially indicating more threat-related stress in these veterans. Furthermore, novices in the high tradeoff condition had moderately significantly lower increase in normalized maximum BP (M = 42.9, SD = 9.9) in comparison to the increase in veterans in the high tradeoff conditions (M = 54.4, SD = 24.1). These results show statistical significance on an individual level; however, when Bonferroni correction is applied, none of these results would be statistically significant. Thus, the data failed to reject the null hypothesis.

Experiment 2: Time Pressure

The complexity of a decision task is influenced by many variables (e.g., number of alternatives available, the attributes and dimensions of information), but a key consideration may be time pressure (Payne, et al., 1993). Time pressure is said to occur whenever the time available for a decision task is perceived as being shorter than what is normally required for the activity (MacGregor, 1993; Svenson & Edland, 1987). Researchers have found when investigating the effects of time pressure on decision making, that performance under time pressure was significantly reduced from performance under normal conditions (Entin & Serfaty, 1999; Payne, et al., 1993). Thus, this scenario further evaluates the impact of time pressure on the decision-making task.

For this experiment, variances for all included analyses are assumed equal. Utilization of Equation 6 confirmed this assumption.

Time to Decision by Time Pressure

When time pressure increases, decision makers first attempt to accelerate information processing (Payne, et al., 1988). Research suggests that as time pressure increases, the amount of time spent processing information decreased substantially (Ben-Zur & Breznitz, 1981).

Overall, across all participants (*N* = 62) the average time to decision was 79.86 seconds (*SD* = 63.82). It was anticipated that time to decision in the low time pressure group will be longer, as the cues in the scene (rate of accumulation of smoke from the ceiling) indicate that more time will be available for the participant to consider all the options. A single-tail pooled-variance *t* test was used to analyze for significance between the low time pressure and the high time pressure groups. The following hypotheses were employed to examine this difference:

$H13_o$: Time to decision in the low time pressure group is not significantly longer than time to decision in the high time pressure group.

$H13_a$: Time to decision in the low time pressure group is significantly longer than time to decision in the high time pressure group.

Table 35 provides details on time to decision for the low and the high time pressure groups. The significance analysis yield $t(60) = 1.59$, $p = .0583$. As was expected, participants under low time pressure took moderately longer to reach a decision; therefore the null hypothesis was rejected and the alternative hypothesis was accepted; however, medium-low effect size (Cohen's $d = 0.40$) indicate the need for caution with respect to generalizing these results.

Table 35: Statistical Summary for Time to Decision by Time Pressure

Time Pressure	***n***	***M***	***SD***	***SE***	***t* ratio**	***p*-value**
Low	31	92.61	69.05	11.32	1.59	.0583**
High	31	67.11	56.38	11.32		

* α ≤ .05 for significance; ** .05< α ≤.10 for moderate significance

Information Processed by Time Pressure

Research suggests that a "key distinction" among decision tasks is whether decision makers explicitly ignore potentially relevant information (Payne, et al., 1988, p. 30). To quantify the total amount of information processed, cells each participant reviewed in making a final selection were counted. This method determines whether decision makers tended to reduce the amount of information processed, or attempted to process all relevant information in solving a decision problem.

Research also suggests that decision makers, when under time pressure, tend to accelerate processing (Ben-Zur & Breznitz, 1981; Miller, 1960; Payne, et al., 1988). When time pressure increases, and it is not possible to process the information any faster, the decision maker resorts to a higher level of selectivity, meaning they process only a subset of (what they perceive to be the) the most important information, referred to as filtration (Miller, 1960). The decision matrix in Experiment 2 provided 16 different cells of information, and the total amount of information examined varied from quite cursory (zero cells reviewed) to somewhat more comprehensive (12 cells reviewed).

Overall, across all participants (N = 62), the average amount of information processed was 2.52 cells (SD = 2.50). It was anticipated that the information processed in the low time pressure group would be greater, as the more time available in the scenario would afford participants the opportunity to review and process a greater amount of information to make a decision. A single-tail pooled-variance t test was used to analyze for significance between the low time pressure and the high time pressure groups. The following hypotheses were employed to examine this difference:

$H14_o$: The amount of information processed in the low time pressure group is not significantly greater than the amount of information processed in the high time pressure group.

$H14_a$: The amount of information processed in the low time pressure group is significantly greater than the amount of information processed in the high time pressure group.

Table 36 provides details on the information processed for the low and the high time pressure groups. The significance analysis yield $t(60) = 0.29$, p = .1825. Participants under low time pressure did not process a significantly greater amount of information to reach a decision; therefore the data failed to reject the null hypothesis.

Table 36: Statistical Summary for Information Processed by Time Pressure

Time Pressure	***n***	***M***	***SD***	***SE***	***t* ratio**	***p*-value**
Low	31	2.81	2.27	0.45	0.29	.1825
High	31	2.23	2.72	0.45		

* $\alpha \leq .05$ for significance; ** $.05 < \alpha \leq .10$ for moderate significance

Information Search Patterns by Time Pressure

SI provides an indication of the orientation during information acquisition (Mintz, et al., 1997). Similarly to Experiment 1, Equation 5 was used to calculate SI values. Overall, across all participants (N = 62), the average SI was 0.38 (SD = 0.73). It was anticipated that the information review pattern in the low time pressure group would be less alternative-based, as increased time pressure is said to result in a more dimensionally-based decision strategy (lower SI). A single-tail pooled-variance t test was used to analyze for significance between the low time pressure and the high time pressure groups. The following hypotheses were employed to examine this difference:

$H15_o$: The information search patterns in the low time pressure group are not significantly more alternative-based than information search patterns in the high time pressure group.

$H15_a$: The information search patterns in the low time pressure group are significantly more alternative-based than information search patterns in the high time pressure group.

Table 37 provides details on the search indices for the low and the high time pressure groups. The significance analysis yield $t(60) = 0.65$, $p = .2592$. The data indicated that there was no significant difference in search pattern orientation between time pressure conditions. Hence, the data failed to reject null hypothesis.

Table 37: Statistical Summary for Search Indices by Time Pressure

Time Pressure	*n*	*M*	*SD*	*SE*	*t* ratio	*p*-value
Low	31	0.32	0.68	0.13	0.65	.2592
High	31	0.44	0.78	0.13		

* α ≤ .05 for significance; ** .05< α ≤.10 for moderate significance

Decision Strategy by Time Pressure

Figure 19 displays distribution of decision strategy by time pressure. Regardless of high (*n* = 31) or low (*n* = 31) time pressure, more participants utilized RPD. More than half the participants (*n* = 17, 54.8%) in high time pressure utilized RPD, while nearly half (*n* = 15, 48.4%) utilized RPD in low time pressure. However, a Pearson's chi-square analysis revealed no statistically significant relationship between distribution of decision strategies and time pressure, X^2 (6, *N* = 62) = 4.93, *p* = .6194. It should be noted that this test may not be reliable, as the average cell count was less than five. Participants in the high time pressure scenario did utilize more purely alternative-based decision strategies (SAT, RPD), and less EBA, a purely dimensionally-based strategy.

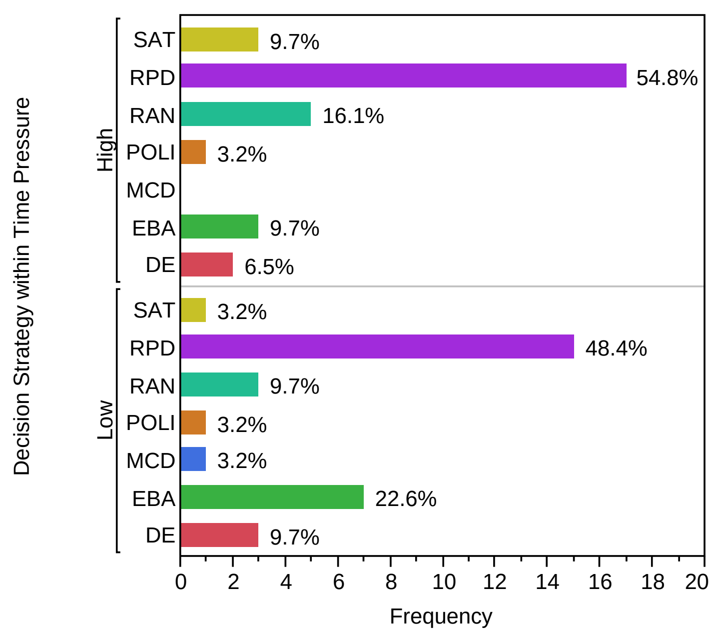


Figure 19: Decision Strategy by Time Pressure.
Note. DE = diminished expectations; EBA = elimination by aspect; MCD = majority of conforming decisions; POLI = poliheuristic; RAN = random decision strategy; RPD = recognition primed decisions; SAT = satisficing.

Final Choice by Time Pressure

To examine whether the addition of high time pressure leads to a change in the selection pattern of firefighters, a Pearson's chi-square analysis was performed, which revealed no statistically significant relationship between distribution of final choice selection and time pressure, X^2 (3, *N* = 62) = 1.57, *p* = .6658. It should be noted that this test may not be reliable, as the average cell count was less than five. Figure 20 displays final choice by high (*n* = 31) and low (*n* = 31) time pressure (see pages 130-132 for a review and evaluation of the final choice options). Regardless of time pressure levels, more than half (*n* = 34, 55%) of all the participants (*N* = 62) selected to *attack* the fire (i.e., *attack*). More than half the participants selected *attack* in both high (*n* = 17, ~58%) and low (*n* = 16, ~51%) time pressure. Of the participants selecting to *back out*, those under low time pressure (*n* = 9, ~32%) nearly doubled the amount that did under high time pressure (*n* = 5, ~13%).

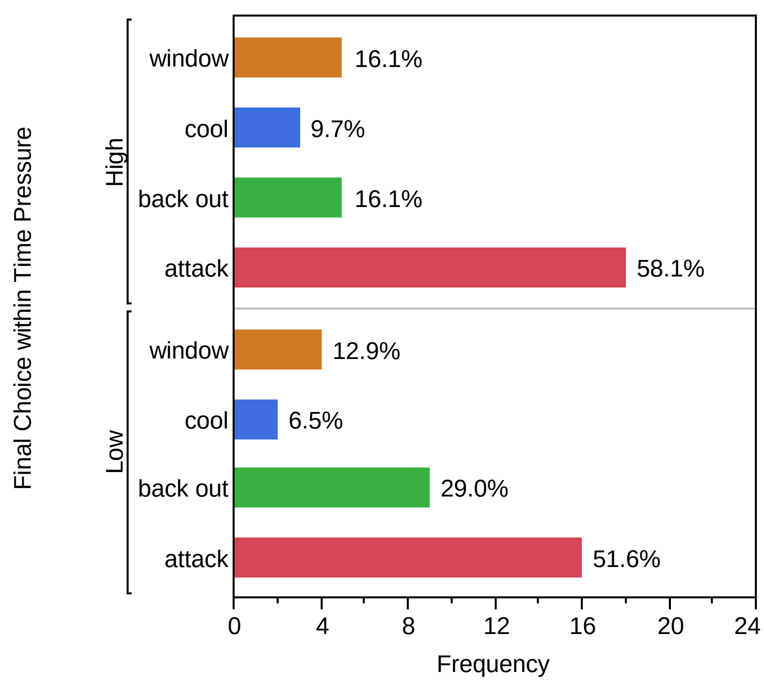


Figure 20: Final Choice by Time Pressure.

Physiological Response by Time Pressure

Overall, physiological responses were obtained from 61 participants. Changes in HR and BP were calculated as provided in Equations 1 through 4. Due to equipment difficulties, one participant's results were not included throughout all the physiological data.

It was anticipated that under low time pressure, the results from the physiological data would show responses more typical of challenge-related stress (increase in heart rate, but a stable or decreasing blood pressure). A single-tail *t* test was used to analyze for significance in normalized HR and BP between the low time pressure and the high time pressure groups. The following hypotheses were employed to examine this difference:

$H16_o$: Stress in the low time pressure group is not significantly more challenge-related than stress in the high time pressure group.

$H16_a$: Stress in the low time pressure group is significantly more challenge-related than stress in the high time pressure group.

Table 38 provides details on the normalized maximum change in HR for the low and the high time pressure groups. The significance analysis for the normalized maximum change in HR yield $t(59) = 1.92$, $p = .0301$, with a medium effect size (Cohen's $d = 0.49$), indicating higher change in normalized maximum HR under the low-pressure condition.

Table 38: Statistical Summary for Normalized Maximum HR by Time pressure

Time Pressure	***n***	***M***	***SD***	***SE***	***t* ratio**	***p*-value**
Low	30	70.05	62.70	9.73	1.92	.0301*
High	31	43.91	42.20	9.57		

* $\alpha \le .05$ for significance; ** $.05 < \alpha \le .10$ for moderate significance

To assure that the opposite effect did not occur (e.g., threat-related stress), the significance of the decrease in HR was tested. Table 39 shows that the normalized minimum HR yield $t(59) = 0.47$, $p = .3208$.

Table 39: Statistical Summary for Normalized Minimum HR by Time pressure

Time Pressure	*n*	*M*	*SD*	*SE*	*t* ratio	*p*-value
Low	30	-14.64	18.56	3.55	0.47	.3208
High	31	-12.31	20.24	3.49		

* α ≤ .05 for significance; ** .05< α ≤.10 for moderate significance

Table 40 provides details on the normalized maximum change in BP for the low and the high time pressure groups. The significance analysis for the normalized maximum change in BP yield $t(59) = 0.45$, $p = .3254$.

Table 40: Statistical Summary for Normalized Maximum BP by Time Pressure

Time Pressure	*n*	*M*	*SD*	*SE*	*t* ratio	*p*-value
Low	30	42.02	41.24	5.87	0.45	.3254
High	31	38.27	19.74	5.78		

* α ≤ .05 for significance; ** .05< α ≤.10 for moderate significance

To assure that the opposite effect did not occur (e.g., threat-related stress), the significance of the decrease in BP was tested. Table 41 shows that the normalized minimum BP yield $t(59) = 0.26$, $p = .3961$.

Table 41: Statistical Summary for Normalized Minimum BP by Time Pressure

Time Pressure	*n*	*M*	*SD*	*SE*	*t* ratio	*p*-value
Low	30	26.80	38.78	5.61	0.26	.3961
High	31	24.71	20.11	5.52		

* α ≤ .05 for significance; ** .05< α ≤.10 for moderate significance

As expected, participants under low time pressure demonstrated cardiovascular profiles that are more typical to challenge-related stress than these profiles under the high time pressure condition. Therefore the null hypothesis was rejected and the alternative hypothesis was accepted.

Experiment 2: Experience

Time to Decision by Experience

Overall, across all novice and veteran participants ($N = 62$), the average time to decision was 79.86 seconds ($SD = 63.82$). It was anticipated that time to decision in the novice group would be longer, as veterans are expected to make more expedient decisions. A single-tail pooled-variance *t* test was used to analyze for significance between the novice and veteran groups. The following hypotheses were employed to examine this difference:

$H17_o$: Time to decision in the novice experience group is not significantly longer than time to decision in the veteran experience group.

$H17_a$: Time to decision in the novice experience group is significantly longer than time to decision in the veteran experience group.

Table 42 provides details on the information processed for the novice and veteran groups. The significance analysis yield $t(60) = 1.22$, $p = .1137$. The time to decision among veteran group was not longer than the time to decision in the novice group; therefore the data failed to reject the null hypothesis.

Table 42: Statistical Summary for Time to Decision by Experience

Experience	*n*	*M*	*SD*	*SE*	*t* ratio	*p*-value
Novice	23	67.04	32.04	6.68	1.22	.1137
Veteran	39	87.42	76.07	12.18		

* α ≤ .05 for significance; ** .05< α ≤.10 for moderate significance

Information Processed by Experience

Overall, across all novice and veteran participants (*N* = 62), the average amount of information processed was 2.52 cells (*SD* = 2.50). It was anticipated that information processed in the novice group would be greater, as veteran's abilities to perform situation recognition either from prior knowledge or expertise would lead to extremely expedient decision-making (Warwick, et al., 2001). A single-tail pooled-variance *t* test was used to analyze for significance between novice and veteran groups. The following hypotheses were employed to examine this difference:

H18$_o$: The amount of information processed in the novice experience group is not significantly greater than the amount of information processed in the veteran experience group.

H18$_a$: The amount of information processed in the novice experience group is significantly greater than the amount of information processed in the veteran experience group.

Table 43 provides details on the information processed for the novice and veteran groups. The significance analysis yield $t(60) = 1.14$, $p = .1282$. Amount of information processed was not affected by experience; therefore the data failed to reject the null hypothesis.

Table 43: Statistical Summary for Information Processed by Experience

Experience	***n***	***M***	***SD***	***SE***	***t* ratio**	***p*-value**
Novice	23	2.04	1.89	0.52	1.14	.1282
Veteran	39	2.79	2.78	0.40		

* α ≤ .05 for significance; ** .05< α ≤.10 for moderate significance

Information Search Patterns by Experience

Overall, across all novice and veteran participants (*N* = 62), the average search indices (SI) was 0.38 (*SD* = 0.73). It was anticipated that the information search pattern in the novice group would be less alternative-based, as lack of expertise may lead participants towards less cognitively-demanding, dimension-based, review mode. A single-tail *t* test was used to analyze for significance between the novice and veteran groups. The following hypotheses were employed to examine this difference:

H19$_o$: The information search patterns in the novice experience group are not significantly less alternative-based than information search patterns in the veteran experience group.

$H19_a$: The information search patterns in the novice experience group are significantly less alternative-based than information search patterns in the veteran experience group.

Table 44 provides details on the SI for the novice and the veteran groups. The significance analysis yield $t(60) = 1.12$, $p = .1342$. The information search pattern among the novice group was not significantly less alternative-based than the information search patterns in the veteran group; thus the data failed to reject the null hypothesis.

Table 44: Statistical Summary for Search Indices by Experience

Experience	***n***	***M***	***SD***	***SE***	***t* ratio**	***p*-value**
Novice	23	0.25	0.82	0.15	1.12	.1342
Veteran	39	0.46	0.66	0.12		

* α ≤ .05 for significance; ** .05< α ≤.10 for moderate significance

Decision Strategy by Experience

Figure 21 provides distribution of decision strategies by experience level. A Pearson's chi-square analysis revealed no statistically significant relationship between decision strategy distribution by experience, X^2 (6, N = 62) = 6.21, p = .4001. It should be noted that this test may not be reliable, as the average cell count was less than five.

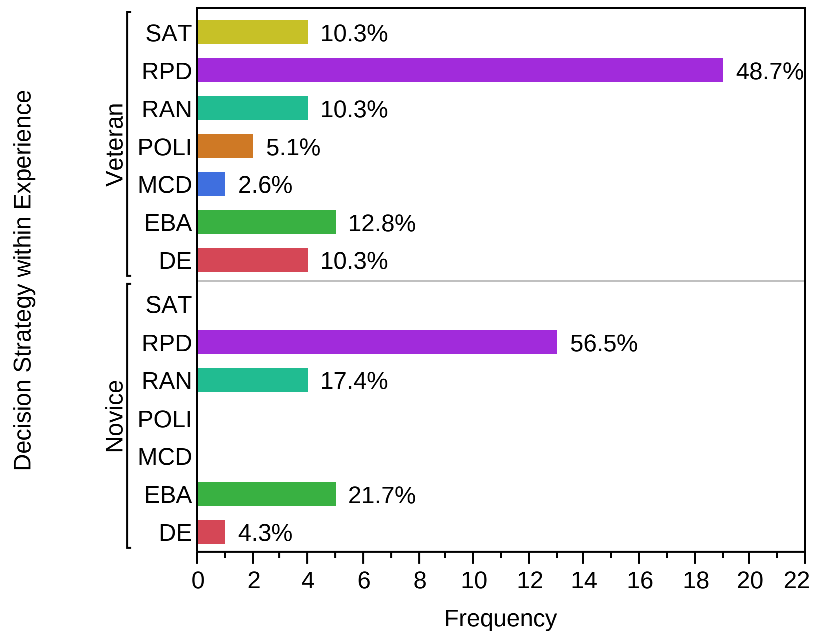


Figure 21: Decision Strategy by Experience.
Note. DE = diminished expectations; EBA = elimination by aspect; MCD = majority of conforming decisions; POLI = poliheuristic; RAN = random decision strategy; RPD = recognition primed decisions; SAT = satisficing.

Final Choice by Experience

Figure 22 displays final choice by experience level. Veterans (n = 39) and novices (n = 23) selected *attack* (veterans n = 19, 48.7%; novices n =15, 65.2%) more frequently than other choices. *Back out* (n = 9, 25.6%), *cool* (n = 4, 10.3%), and *window* (n = 5, 15.4%) were selected more frequently by veterans. *Back out* was selected by more than twice as many veterans as novices. However, a Pearson's chi-square analysis revealed no statistically significant relationship between the distribution of final choice selection and experience, X^2 (3, N = 62) = 1.84, p = .6073. It should be noted that this test may not be reliable, as the average cell count was less than five.

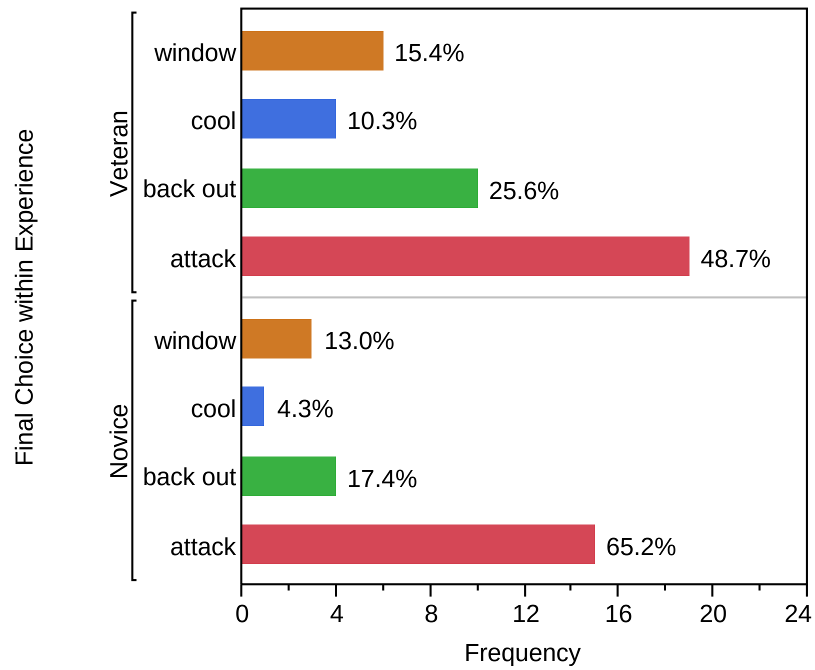


Figure 22: Final Choice by Experience.

Physiological Response by Experience

The expectation was that veterans would demonstrate cardiovascular profiles that are more typical to challenge-related stress (lower BP and higher HR) than these profiles among novices. A single-tail *t* test was used to analyze for significance in changes in normalized HR and BP between the novice and the veteran groups. The following hypotheses were employed to examine this difference:

$H20_o$: Stress in the novice experience group is not significantly more challenge-related than stress in the veteran experience group.

$H20_a$: Stress in the novice experience group is significantly more challenge-related than stress in the veteran experience group.

Table 45 provides details on the normalized maximum change in HR for the novice and veteran groups. The significance analysis for the normalized maximum change in HR yield $t(59) = 0.65$, $p = .2603$.

Table 45: Statistical Summary for Normalized Maximum HR by Experience

Experience	***n***	***M***	***SD***	***SE***	***t* ratio**	***p*-value**
Novice	23	62.59	53.68	11.41	0.65	.2603
Veteran	38	53.24	55.32	8.88		

* α ≤ .05 for significance; ** .05< α ≤.10 for moderate significance

To assure that the opposite effect did not occur (e.g., threat-related stress), the significance of the decrease in HR was tested. Table 46 shows that the normalized minimum HR yield $t(59) = 0.00$, $p = .4991$.

Table 46: Statistical Summary for Normalized Minimum HR by Experience

Experience	***n***	***M***	***SD***	***SE***	***t* ratio**	***p*-value**
Novice	23	-13.45	12.95	4.06	0.00	.4991
Veteran	38	-13.46	22.47	3.16		

* α ≤ .05 for significance; ** .05< α ≤.10 for moderate significance

Table 47 provides details on the normalized maximum BP for the novice and veteran groups. The significance analysis for the normalized maximum change in BP yield $t(59) = 0.64$, $p = .2624$.

Table 47: Statistical Summary for Normalized Maximum BP by Experience

Experience	***n***	***M***	***SD***	***SE***	***t* ratio**	***p*-value**
Novice	23	36.74	13.22	6.69	0.64	.2624
Veteran	38	42.16	39.23	5.21		

* α ≤ .05 for significance; ** .05< α ≤.10 for moderate significance

To assure that the opposite effect did not occur (e.g., threat-related stress), the significance of the decrease in BP was tested. Table 48 shows that the normalized minimum BP yield $t(59) = 1.12$, $p = .1335$.

Table 48: Statistical Summary for Normalized Minimum BP by Experience

Experience	*n*	*M*	*SD*	*SE*	*t* ratio	*p*-value
Novice	23	20.13	18.47	6.35	1.12	.1335
Veteran	38	29.14	35.70	4.94		

* $\alpha \leq .05$ for significance; ** $.05 < \alpha \leq .10$ for moderate significance

The results indicated that there is no significant difference between the type of stress that novices and veterans experienced; therefore, the data failed to reject the null hypothesis.

Experiment 2: Time Pressure by Experience

Time to Decision by Time Pressure and Experience

Overall, across all novice and veteran participants in low time pressure (n = 31), the average time to decision was 92.61 seconds (SD = 69.05), and in high time pressure (n = 31) the average time to decision was 67.11 seconds (SD = 56.38). Across all novice participants in both high and low time pressure (n = 23) the average time to decision was 67.04 seconds (SD = 32.04), whereas for veteran participants (n = 39) the average time to decision was 87.42 seconds (SD = 76.07).

It was anticipated that time to decision for the novice group under low time pressure would be the longest for several reasons. Cues in the scene indicated that more time is available, veterans are expected to make more expedient decisions, and research suggests that as time pressure increases, the amount of time spent processing information decreases substantially (Ben-Zur & Breznitz, 1981).

To determine level of interaction of time to decision based on experience and time pressure, the time pressure and experience variables were included in a two-way analysis of variance (ANOVA). The following hypotheses were employed to examine this difference:

$H21_o$: Time to decision is not significantly different by time pressure and experience.

$H21_a$: Time to decision is significantly different by time pressure and experience.

The main effects model resulted in *F*(3, 58) = 1.96, *p* = .1301. Under this model, neither time pressure, *F*(1, 58) = 2.28, *p* = .1367, nor experience, *F*(1, 58) = 2.07, *p* =.1557, were found to be significant. There was also no significance in the time to decision when analyzing for an interaction of time pressure and experience, *F*(1, 58) = 0.9359, *p* = .3374.

Table 49 shows further details the statistically significant results *t*(58) = 2.05, *p* =.0449. The time to decision by veterans under low time pressure (*LSM* = 110.75) was longer than under high time pressure (*LSM* = 69.40). It was not the novice group that took longer to make a decision, but rather the veteran participants. However, the results also show that under time pressure and experience, time to decision is significantly different; therefore the null hypothesis was rejected and the alternative hypothesis was accepted.

Table 49: LS Means Difference Table for Time to Decision by Time Pressure and Experience

Level			**Least Sq Mean**
Low Time pressure, Veteran	A		110.75
Low Time pressure, Novice	A	B	70.58
High Time pressure, Veteran		B	69.40
High Time pressure, Novice	A	B	61.53

Note: Levels not connected by same letter are significantly different.

Because Experiment 2 is based on time pressure induced by accumulating speed and density of smoke dropping from the ceiling, it stands to reason to review the level of smoke at the time each participant made their final choice. Firefighters may typically walk in smoke that is around head-height (~≥6'), but will begin to crawl when it reaches waist height (~≤3'). At approximately knee height (~2-3'), when accompanied by rapid accumulation and increasing density, firefighters will expect potential flashover. When analyzing smoke height from the floor at time to decision as the dependent variable, there were insignificant differences among the four groups, as seen in Table 50.

Table 50: Statistical Summary for Smoke Height from the Floor by Experience

Time Pressure	Experience	*n*	*p*-value	*LSM*	*SD*	*SE*
Low	Novice	14	0.1610	8.43	0.70	0.32
	Veteran	17		7.81	1.49	0.29
High	Novice	9	0.5660	7.70	1.08	0.36
	Veteran	22		6.56	5.78	1.23

* $\alpha \leq .05$ for significance; ** $.05 < \alpha \leq .10$ for moderate significance

Information Processed by Time Pressure and Experience

Overall, across all novice and veteran participants in low time pressure (n = 31), the average amount of information processed was 2.81 cells (SD = 2.27), and in high time pressure (n = 31) the average amount of information processed was 2.23 cells (SD = 2.72). Overall, across all novice participants in both low and high time pressure (n = 23), the average amount of information processed was 2.04 cells (SD = 1.89), whereas for veteran participants (n = 39) the average amount of information processed was 2.79 cells (SD = 2.78).

It was anticipated that the amount of information processed in the novice group under low time pressure will be the longest, for two reasons. Veterans' abilities to perform situation recognition either from prior knowledge or expertise would lead to extremely expedient decision making (Warwick, et al., 2001). Also, the greater the time available, the more it will allow reviewing and processing a larger amount of information.

To determine level of interaction of information processed based on experience and time pressure, both these variables were included in a two-way analysis of variance (ANOVA). The following hypotheses were employed to examine this difference:

$H22_0$: Amount of information processed is not significantly different by time pressure and experience.

$H22_a$: Amount of information processed is significantly different by time pressure and experience.

The result for the main effects model was *F*(3, 58) = 0.94, *p* = .4263. Under this model, both time pressure, *F*(1, 58) = 1.49, *p* = .2279, and experience, *F*(1, 58) = 1.83, *p* = .1809, were found to be insignificant. There was also no significance in the information processed when analyzing for an interaction of time pressure and experience, *F*(1, 58) = 0.27, *p* = .6044.

Table 51 shows further details which revealed that there was no statistical difference between information processed among these groups; therefore, the data failed to reject the null hypothesis.

Table 51: LS Means Difference Table for Information Processed by Time Pressure and Experience

Level		**Least Sq Mean**
Low Time Pressure, Veteran	A	3.06
High Time Pressure,, Veteran	A	2.59
Low Time Pressure,, Novice	A	2.50
High Time Pressure,, Novice	A	1.33

Note: Levels not connected by same letter are significantly different.

Information Search Patterns by Time Pressure and Experience

Overall, across all novice and veteran participants in low time pressure (*n* = 31), the average SI was 0.32 (*SD* = 0.68), while in the high time pressure (*n* = 31) the average SI was 0.44 (*SD* = 0.78). Across all novice participants in both low and high time pressure (*n* = 23), the average SI was 0.25 (*SD* = 0.82), whereas for all veteran participants (*n* = 39), the average SI was 0.46 (*SD* =0.66).

It was anticipated that the information search patterns in the novice group under high time pressure would be the least alternative-based for two reasons. A lack of expertise may lead participants towards a less cognitively-demanding, dimension-based, review mode (Payne, et al., 1993), and increased time pressure is said to result in a more dimensional-based decision strategy (lower SI).

To determine level of interaction of information search patterns based on experience and time pressure, both these variables were included in a two-way analysis of variance (ANOVA). The following hypotheses were employed to examine this difference:

$H23_o$: Information search patterns are not significantly different by time pressure and experience.

$H23_a$: Information search patterns are significantly different by time pressure and experience.

The result for the main effects model was $F(3, 58) = 0.4767$, $p = .6997$. Under this model neither time pressure, $F(1, 58) = 0.20$, $p = .6596$, nor experience, $F(1, 58) = 1.01$, $p = .3190$, were found to be significant. There was also no significance in the information search patterns when analyzing for an interaction of time pressure and experience, $F(1, 58) = 0.00$, $p = .9799$. Table 52 shows further details which revealed that there was no statistical difference between information search patterns among these groups; therefore, the data failed to reject the null hypothesis.

Table 52: LS Means Difference Table for Information Search Patterns by Time Pressure and Experience

Level		Least Sq Mean
High Time Pressure, Veteran	A	0.50
Low Time Pressure, Veteran	A	0.41
High Time Pressure, Novice	A	0.30
Low Time Pressure, Novice	A	0.21

Decision Strategy by Time Pressure and Experience

When analyzing decision strategy grouped by time pressure and experience, there were four groups: 1) veteran in the low time pressure condition (*n* =17); 2) novice in the low time pressure condition (*n* = 14); 3) veteran in the high time pressure condition (*n* = 22); and 4) novice in the high time pressure condition (*n* =9). As can be seen from Figure 23, RPD was more prevalent among both novices and veterans in high time pressure conditions. DE was more predominant among veterans. However, a series of Pearson's chi-square analyses revealed no statistically significant relationship between decision strategy distribution and the interaction of time pressure and experience, X^2 (12, N = 62) = 13.48, p = .3350. It should be noted that these tests may not be reliable, as the average cell count was less than five.

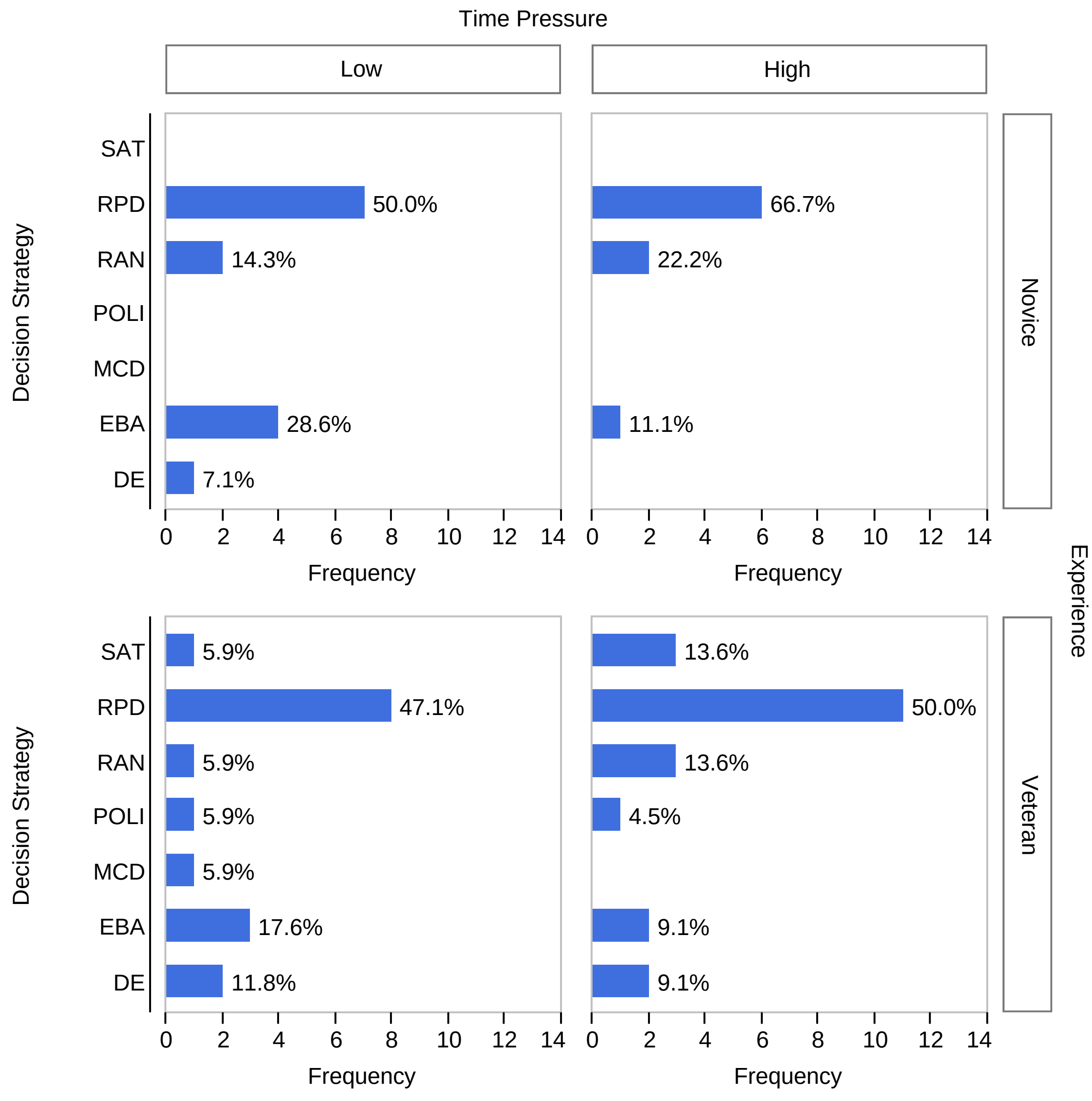


Figure 23: Decision Strategy by Time Pressure and Experience.
Note. DE = diminished expectations; EBA = elimination by aspect; MCD = majority of conforming decisions; POLI = poliheuristic; RPD = recognition primed decisions; SAT = satisficing.

Tables 53 (high time pressure) and 54 (low time pressure) present the decision strategy by experience and the scenario as identified by each participant (e.g., *pre-flashover*, *incipient*, and *pre-backdraft*).

Table 53: Scenario Identified by Decision Strategy and High Time Pressure

	Pre-Flashover		Incipient		Pre-Backdraft	
Experience	Novice	Veteran	Novice	Veteran	Novice	Veteran
DE	0	1	0	0	0	1
EBA	1	0	0	2	0	0
LEX	0	0	0	0	0	0
MCD	0	0	0	0	0	0
POLI	0	0	0	0	0	1
POLI2DE	0	0	0	0	0	0
RAN	0	1	2	0	0	2
RPD	2	5	4	6	0	0
SAT	0	1	0	2	0	0
WADD	0	0	0	0	0	0
Total	3	8	6	10	0	4

Note. DE = diminished expectations; EBA = elimination by aspect; LEX = lexicographic; MCD = majority of conforming decisions; POLI = poliheuristic; POLI2DE = poliheuristic to diminished expectations; RAN = random decision strategy; RPD = recognition primed decisions; SAT = satisficing; WADD = weighted additive.

Table 54: Scenario Identified by Decision Strategy and Low Time Pressure

	Pre-Flashover		Incipient		Pre-Backdraft	
Experience	Novice	Veteran	Novice	Veteran	Novice	Veteran
DE	1	2	0	0	0	0
EBA	4	0	0	2	0	1
LEX	0	0	0	0	0	0
MCD	0	1	0	0	0	0
POLI	0	0	0	1	0	0
POLI2DE	0	0	0	0	0	0
RAN	1	0	1	1	0	0
RPD	3	4	4	3	0	1
SAT	0	1	0	0	0	0
WADD	0	0	0	0	0	0
Total	9	8	5	7	0	2

Note. DE = diminished expectations; EBA = elimination by aspect; LEX = lexicographic; MCD = majority of conforming decisions; POLI = poliheuristic; POLI2DE = poliheuristic to diminished expectations; RAN = random decision strategy; RPD = recognition primed decisions; SAT = satisficing; WADD = weighted additive.

Tables 53 and 54 also present the decision strategy utilized by the participants. While under high time pressure, none of the novices miss-identified the scenario as *pre-backdraft.* However four veterans (~18%) misidentified the scenario. While under low time pressure, two veterans (~12%) and none of the novices misidentified the scenario as *pre-backdraft.*

Final Choice by Time Pressure and Experience

When analyzing final choice grouped by time pressure and experience, there were four groups: 1) veteran in the low time pressure condition (*n* =17); 2) novice in the low time pressure condition (*n* = 14); 3) veteran in the high time pressure condition (*n* = 22); and 4) novice in the high time pressure condition (*n* =9).

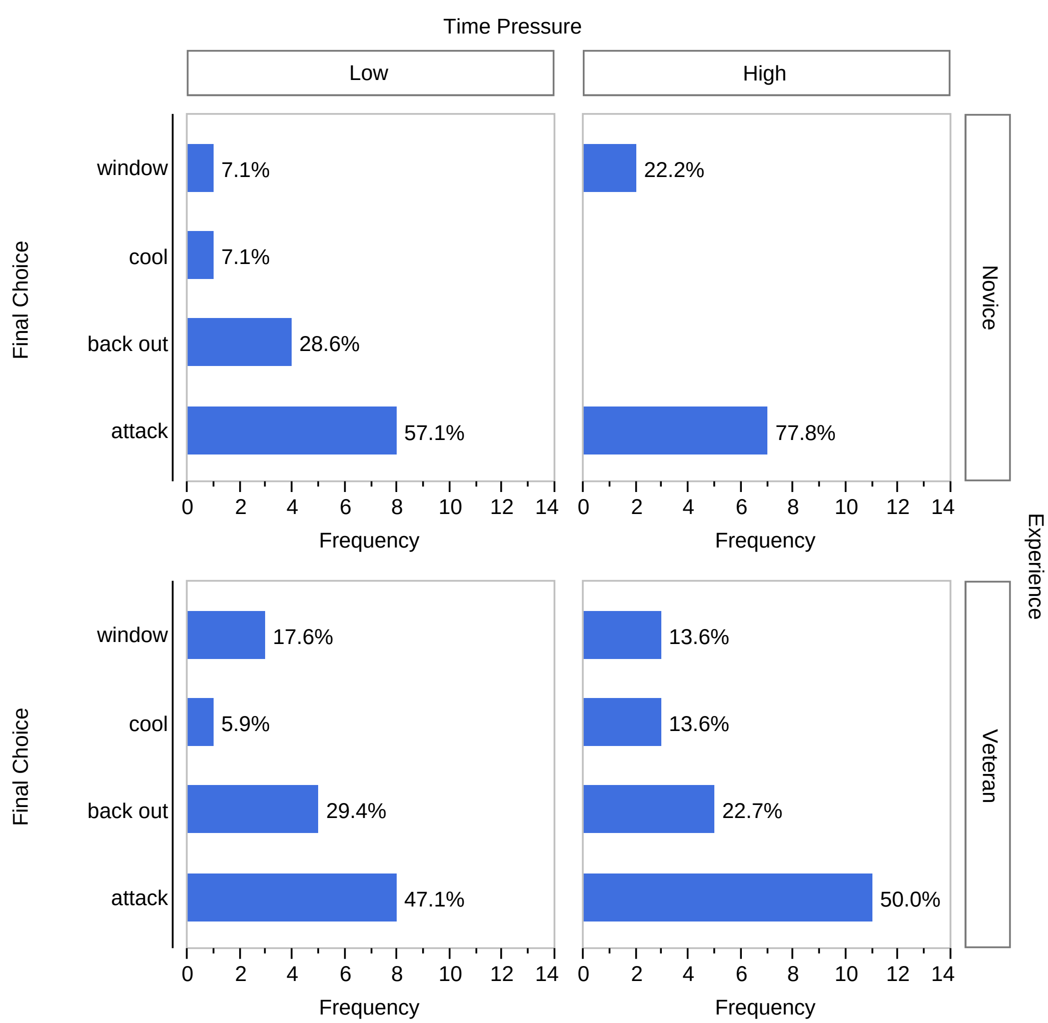


Figure 24: Final Choice by Time Pressure and Experience.

As can be seen in Figure 24, *attack* was most prevalent among veterans and novices, regardless of time pressure. Overall, *back out* was more prevalent in low time pressure, and by veterans at twice the frequency of novices. *Window* remained a second or third level option regardless of time pressure or experience level. A series of Pearson's chi-square analysis revealed no statistically significant relationship between final choice selection and the interaction of time pressure and experience, X^2 (6, N = 62) = 3.80, p = .7043. It should be noted that these tests may not be reliable, as the average cell count was less than five.

Final Choice under Low Time Pressure

Table 55 displays the overall final choice based on experience for participants under the low time pressure scenario.

Table 55: Final Choice by Experience (Low Time Pressure)

Experience	***Attack***	***Back out***	***Cool***	***Window***
Novice	8 (57%)	4 (29%)	1 (7%)	1 (7%)
Veteran	8	5	1	3

Final Choice under High Time Pressure

Table 56 displays the overall final choice based on experience for participants under the high time pressure scenario.

Table 56: Final Choice by Experience (High Time Pressure)

Experience	***Attack***	***Back out***	***Cool***	***Window***
Novice	7 (77.8%)	0	0	2 (22.2)
Veteran	11 (50%)	5 (22.8)	3 (13.6)	3 (13.6)

Physiological Response by Time Pressure and Experience

To determine whether time pressure conditions and experience have statistically significant main effect on physiological response, two-way ANOVA were conducted on changes of the normalized minimum and maximum HR and BP. The following hypotheses were employed for physiological response by time pressure condition and experience level:

H24$_o$: Stress is not significantly different by time pressure and experience.

H24$_a$: Stress is significantly different by time pressure and experience.

Table 57 provides a summary of the changes in normalized minimum HR by experience and time pressure conditions. Table 58 provides the results of an ANOVA on the interactions among time pressure and experience level for changes in normalized minimum HR. Similarly:

- Tables 59 and 60 provide details for changes in normalized maximum HR.
- Tables 61 and 62 provide details for changes in normalized minimum BP.
- Tables 63 and 64 provide details for changes in normalized maximum BP.

Table 57: Statistical Summary for Normalized Minimum HR by Time Pressure and Experience

Level	*n*	*M*	*SD*	*SEM*
NOV-Fast	9	-16.46	14.67	4.89
NOV-Slow	14	-11.51	11.88	3.17
VET-Fast	22	-10.61	22.21	4.73
VET-Slow	16	-17.37	22.95	5.74

Table 58: Interaction of Normalized Minimum HR by Time Pressure and Experience

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
VET-Fast	VET-Slow	6.77	6.43	-6.10	19.64	.2969
NOV-Slow	VET-Slow	5.87	7.16	-8.47	20.20	.4159
VET-Fast	NOV-Fast	5.85	7.74	-9.65	21.35	.4527
NOV-Slow	NOV-Fast	4.95	8.36	-11.78	21.69	.5558
NOV-Fast	VET-Slow	0.91	8.15	-15.41	17.24	.9111
VET-Fast	NOV-Slow	0.89	6.69	-12.49	14.29	.8934

* $\alpha \leq .05$ for significance; ** $.05 < \alpha \leq .10$ for moderate significance

Table 59: Statistical Summary for Normalized Maximum HR by Time pressure and Experience

Level	*n*	*M*	*SD*	*SEM*
NOV-Fast	9	51.59	45.30	15.10
NOV-Slow	14	69.65	58.95	15.76
VET-Fast	22	40.77	41.55	8.86
VET-Slow	16	70.40	67.74	16.94

Table 60: Interaction of Normalized Maximum HR by Time Pressure and Experience

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
VET-Slow	VET-Fast	29.63	17.77	-5.95	65.21	.1009
NOV-Slow	VET-Fast	28.89	18.49	-8.14	65.91	.1237
VET-Slow	NOV-Fast	18.81	22.53	-26.31	63.93	.4074
NOV-Slow	NOV-Fast	18.06	23.10	-28.21	64.33	.4376
NOV-Fast	VET-Fast	10.83	21.40	-32.02	53.67	.6149
VET-Slow	NOV-Slow	0.75	19.79	-38.89	40.37	.9701

* $\alpha \le .05$ for significance; ** $.05 < \alpha \le .10$ for moderate significance

Table 61: Statistical Summary for Normalized Minimum BP by Time pressure and Experience

Level	*n*	*M*	*SD*	*SEM*
NOV-Fast	9	17.64	15.74	5.25
NOV-Slow	14	21.73	20.44	5.46
VET-Fast	22	27.61	21.29	4.54
VET-Slow	16	31.24	50.01	12.50

Table 62: Interaction of Normalized Minimum BP by Time Pressure and Experience

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
VET-Slow	NOV-Fast	13.60	12.88	-12.19	39.39	.2953
VET-Fast	NOV-Fast	9.97	12.23	-14.52	34.46	.4182
VET-Slow	NOV-Slow	9.51	11.31	-13.14	32.16	.4038
VET-Fast	NOV-Slow	5.88	10.57	-15.27	27.04	.5798
NOV-Slow	NOV-Fast	4.09	13.20	-22.35	30.53	.7580
VET-Slow	VET-Fast	3.63	10.15	-16.71	23.96	.7222

* $\alpha \le .05$ for significance; ** $.05 < \alpha \le .10$ for moderate significance

Table 63: Statistical Summary for Normalized Maximum BP by Time Pressure and Experience

Level	*n*	*M*	*SD*	*SEM*
NOV-Fast	9	36.14	9.98	3.33
NOV-Slow	14	37.12	15.30	4.09
VET-Fast	22	39.15	22.71	4.84
VET-Slow	16	46.31	55.16	13.79

Table 64: Interaction of Normalized Maximum BP by Time Pressure and Experience

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
VET-Slow	NOV-Fast	10.17	13.55	-16.97	37.310	.4562
VET-Slow	NOV-Slow	9.19	11.90	-14.65	33.03	.4433
VET-Slow	VET-Fast	7.16	10.69	-14.24	28.56	.5055
VET-Fast	NOV-Fast	3.01	12.87	-22.77	28.78	.8161
VET-Fast	NOV-Slow	2.03	11.12	-20.24	24.30	.8560
NOV-Slow	NOV-Fast	0.98	13.90	-26.85	28.81	.9441

* $\alpha \leq .05$ for significance; ** $.05 < \alpha \leq .10$ for moderate significance

The analyses indicated that interaction of time pressure and experience did not yield difference in stress; thus, the data failed to reject the null hypothesis.

CHAPTER 6: DISCUSSION

This study examined decision making in the natural environment of the decision maker. A virtual reality environment (VRE) was utilized to mimic a natural setting, while preserving the qualities offered by controlled laboratory environments. This work presents the process and the results of conducting decision making under stress experiments with firefighters in the VRE. More specifically, the experiments addressed how difficult tradeoff levels, time pressure, physiological effects, and experience affect firefighter judgment and choice.

Tradeoff

Several researchers have written general theories regarding the potential tradeoffs between accuracy and effort (Payne, et al., 1993; Weber, Baron, & Loomes, 2001; Klein, et al., 1993). Yet for firefighters, who face extreme tradeoff decisions often on a daily basis, tradeoff research is scarce. As a rule of thumb to assist them in making these tradeoff choices, firefighters can often be heard recanting the fire services' unofficial risk benefit analysis: *risk a lot to save a lot, risk little to save little, risk nothing to save nothing.* To explain further, each time an incident commander chooses to directly attack a fire, a tradeoff is made by placing subordinate firefighters at risk (*risk a lot…*), in exchange for increasing the probability of improving a victim's odds of survival (*…to save a lot*). The prospect of firefighter loss of life is traded off, so to speak, for the potential to save a civilian's life.

To examine the effects of tradeoff levels, firefighters were placed in the VRE assuming the position of the incident commander who has been dispatched and arrived on scene of a reported structure fire. The fire was in a single-family dwelling suggestive of a home found in a typical suburban middle- to upper-middle class neighborhood. There were no visible flames, but thick black smoke, distinctive of incomplete combustion could be observed "puffing" and "sucking" from the doors, windows, and eaves of all sides of the residence. These and other visible signs together are distinctively characteristic of pre-backdraft conditions. Pre-backdraft is a stagnant scenario where the "scene" does not change until a backdraft occurs. The potential for backdraft occurs when a fire's product-gases are starved of oxygen. Backdraft is most simply defined as the “rapid deflagration following the introduction of oxygen into a compartment filled with accumulated unburned fuel” (Fleishmann, 1994, p. 21). Thus, if oxygen is reintroduced into this fire by opening a fire-level door or window, combustion will restart in a rapid and explosive manner.

The tradeoff levels were designed by altering the cues portraying the presence of occupants. These cues provided participants with either strong or weak indications that there may be viable victim(s) in need of rescue, and subsequent actions by participants could either greatly improve or decrease the odds of a successful rescue. Participants encountering the scenario with *high* tradeoff values (most likely to “*risk a lot to save a lot*”), were provided the aforementioned scenario indicative of a home presently occupied: a vehicle in the driveway, empty mailbox, and a clean walkway. Participants in the *low* tradeoff values scenario (“risk a little to save a little”), viewed a house with no car in the driveway, mail overflowing in the mailbox awaiting pickup, and numerous newspapers on the front stoop, providing indication that the door has not been opened in several days and the house may be presently unoccupied.

The Effect of Tradeoff on Time to Decision

The results indicate that tradeoff played a very significant factor in decision tasks, and there were several findings worth noting. Overall, across all participants (N = 62), the average time to decision was 203.35 seconds (SD = 88.64). As was expected, participants under low tradeoff (M = 226.64 seconds, SD = 96.17) took significantly longer to reach a decision, $t(60)$ = 2.13, p = .0188 (see analysis for hypothesis H1), than participants under high tradeoff (M = 180.07 seconds, SD = 74.87). One could theorize that under low tradeoff, there is less of a conflict for firefighters concerned with life safety. A potential explanation is that low tradeoff conditions may allow decision makers to be more apt or willing to confront conflict and utilize compensatory decision strategies, which require higher cognitive demand and thus, can take longer to perform (Riedl, et al., 2008). However, a review of the distribution of decision strategy in the low and high tradeoff (see Figure 13) indicated insignificant difference in the utilization of compensatory strategies between high and low tradeoff conditions (48.3% of the strategies in the low tradeoff condition were compensatory in nature and 45.2% in the high tradeoff). Optionally, the low tradeoff condition established a reduced sense of urgency, thus firefighters utilized more time to reassure their approach, review information, and examine the environment.

The Effect of Tradeoff on Information Processed

Overall, across all participants (N = 62), the average amount of information processed was 6.61 cells (SD = 4.98). It was anticipated that the amount of information processed in the low tradeoff group would be greater, as the cues would provide participants indications that the potential for viable victim(s) in need of rescue is low. Thus, without the need for victim rescue, participants would allow themselves a more thorough review of information before making a decision. As was expected, participants under low tradeoff (M = 7.77 cells, SD = 5.74) processed more information to reach a decision, $t(60)$ = 1.88, p = .0329 (see analysis for hypothesis H2), than participants under high tradeoff (M = 5.45 cells, SD = 3.83). As suggested above, lower urgency in the low tradeoff condition provided an opportunity for enhanced review.

The Effect of Tradeoff on Information Search Patterns

Strategies can be described as either attribute-based or alternative-based. In *attribute-based* decision processing—suggested as less cognitively demanding (Russo & Dosher, 1983)—the implications of several options on a single attribute are processed before a further attribute is considered. In *alternative-based* decision processing, the attribute implications of a single option are considered before moving to the next option for consideration. Thus, attribute-based processing results in a more horizontal-oriented review of information (assuming decision matrix orientation in Figure 1), whereas alternative-based processing results in a more vertical-oriented review of information. Overall, across all participants (N = 62), there was an average SI of 0.09 (SD = 0.69). It was anticipated that the information search patterns in the low tradeoff group would be less alternative-based, as cues to an empty house may lead participants towards a less cognitively-demanding review processing. As expected, SI under low tradeoff (*M* = -0.11, *SD* = 0.69) was significantly more dimension-based, $t(60) = 2.44$, $p = .0089$ (see analysis for hypothesis H3), than under high tradeoff (*M* = 0.30, *SD* = 0.63). As indicated above, distribution of strategies was not sensitive to tradeoff levels. Yet, the results from analysis of search patterns provided significantly higher alternative-based search patterns in the high tradeoff conditions. Thus, in high tradeoff conditions, more resources were devoted for rational processing when an alternative-oriented search was utilized.

The Effect of Tradeoff on Decision Strategy

Two new decision strategies were identified during the analyses of the decision portraits in this study. A thorough review of literature failed to find explicit indications for these strategies.

The first new strategy identified is similar to Poliheuristic (POLI), in that that it involves the use of a two-stage process (Mintz, 2004). However, unlike POLI –which utilizes cognitive heuristics followed by rational choice calculus—this strategy utilizes rational choice calculations followed by cognitive heuristics. Potentially, the decision maker identifies a favorable alternative and is engaged in a thorough review of the implication of the decision dimension on this alternative; then, at some point before finalizing a decision, the decision maker shifts to a dimension-based strategy. This strategy may fall in the framework of variation 2 of the recognition-primed decision model. Klein's (1998) variation 2 suggests that should a decision maker encounter a situation that does not clearly match a typical case, more time may be devoted to diagnosing the situation. Furthermore, if the decision maker misinterprets the situation and fails to realize it until expectancies are violated, they may respond by trying to "build a story to account for some of the inconsistencies" (Klein G., 1998, p. 26). Thus, this decision strategy has been entitled *diminished expectations* (DE) by the ISU researchers.

An even more fitting description of DE may be in the third variation of RPD, where decision makers anticipate difficulties in how their actions play out. Decision makers adjust their course of action or even reject it to look for secondary alternatives. Similarly with DE, a decision maker immediately identifies a scenario and begins processing what little information is required in a rational choice method. However at some point (in the case of DE), the decision maker's expectations are not met, either from an unrecognizable situation or through mental simulation. By checking whether these expectations are satisfied, the decision maker can judge the accuracy of the mental simulation (Klein G., 1998). The greater the differences and the more effort it takes to explain away the conflicting evidence, the less confident the decision maker feels about the decision task diagnosis. It is at this point the decision maker determines that it is necessary to reevaluate alternatives and proceeds to a cognitive heuristic. Figure 25 provides an example of the decision portrait for a participant utilizing DE.

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit	4(186.910)	5(217.870)	6(227.020)	
Size Up Factors	2(146.690)			
Type of Structure	1(128.630)			
Available Resources	3(164.790)			

Figure 25: Diminished Expectations (DE) Decision Strategy Portrait.

The second newly identified decision strategy is a combination of the two multi-stage decision processes of POLI (Mintz, et al., 1994) and DE. Decision makers first use critical dimensions to eliminate alternatives by utilizing a non-compensatory mechanism. Once the choice set has been reduced to alternatives that are acceptable to the decision maker, the process moves to a second stage, involving the evaluation of the surviving acceptable alternative(s) to minimize risk and maximize rewards. However, similar to RPD, when the decision maker's expectations are not met, either from an unrecognizable situation or through mental simulation, the decision maker then reverts back to a rational choice calculus followed by cognitive heuristics. This entire decision process is characterized by the propensity to alternate back and forth from dimension-based to alternative-based processing. Thus, this decision strategy is entitled *poliheuristic to* *diminished expectations* (POLI2DE). DE and POLI2DE should be further studied beyond the scope of this project. Figure 26 provides an example of the decision portrait for a participant utilizing POLI2DE.

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit	1(130.707)	3(171.707)	2(141.017), 4 (185.227), 5 (187.877)	
Size Up Factors			6(194.047)	
Type of Structure			7(201.417)	
Available Resources	10(234.537)	9(223.987)	8(206.467)	

Figure 26: Poliheuristic to Diminished Expectations (POLI2DE) Decision Strategy Portrait.

A Pearson's chi-square analysis revealed no statistically significant relationship between decision strategy distribution and tradeoff, X^2 (8, N = 62) = 5.99, p = .6488. However, a total of 38.7% (n = 24) of the participants utilized no specific decision strategy (RAN). Participants were more likely to utilize the alternative-based decision strategies SAT, and RPD in the high tradeoff condition. Likewise, participants were more likely to utilize the dimension-based decision strategy of LEX, and the multi-stage strategy POLI in low tradeoff versus high tradeoff. DE was the second most frequent decision strategy under both low and high tradeoff. Thus, Table 65 proposes a revision of Table 1, including both DE and POLI2DE.

Table 65: Decision Strategy Properties

Strategy	Alternative- (AL) or Attribute-based (AT)	Compensatory (C) or Non-Compensatory (N)	Consistent (C)or Selective (S)	Cutoff (aspiration) Levels Used? (Y OR N)	Quantitative (QN) or Qualitative (QL)
DE	AL/AT	N	S	Y	QL
EBA	AT	N	S	Y	QL
LEX	AT	N	S	N	QL
MCD	AT	C	C	N	QN
POLI	AT/AL	N	S	Y	QL
POLI2DE	AT/AL/AT	N	S	Y	QL
RPD	AL	N	S	N	QL
SAT	AL	N	S	Y	QL
WADD	AL	C	C	N	QN

Note 1. DE = diminished expectations; EBA = elimination by aspect; LEX = lexicographic; MCD = majority of conforming decisions; POLI = poliheuristic; POLI2DE = poliheuristic to diminished expectations; RPD = recognition primed decisions; SAT = satisficing; WADD = weighted additive.

Note 2. Payne, Bettman, and Johnson (1993, p. 32) have classified EBA, LEX, MCD, SAT, and WADD. Klein (1993) contributed RPD, and Mintz et al. (1997) contributed POLI. This research contributes DE and POLI2DE.

The Effect of Tradeoff on Final Choice

Underlying most decision behavior is the goal to minimize the cognitive effort needed to reach a decision, while still making an optimal decision ("effort-accuracy" framework by Payne et al. 1993). Choices in this senario are: a) attack the fire through the main door (*door*); b) vertically ventilate from a ladder to the roof (*roof*); or c) vertically ventilate off the platform of an aerial ladder truck (*truck*); d) break a window for horizontal ventilation (*window*). If while experiencing low tradeoff (low likelihood of victims), a decision maker were to take the time and gather all available information, the most advantageous choice may be to ventilate from the *roof*. However, with high tradeoff (high likelihood of victims), a more optimal choice may be to break a *window* for ventilation. Table 66 explains the potential conflicting dimensions that a firefighter must consider, in deciding whether and how to mitigate the scene or rescue potential victims. It can be seen, that for each choice, a participant faces the scrutiny of having both optimal and suboptimal evaluations on decision dimensions.

Table 66: Optimality of Final Choice

Attack Fire Through the Main Door (*door*)		Ventilate the Roof from a Ground Ladder (*roof*)		Ventilate the Roof from the Platform of an Aerial Ladder (*truck*)		Break a Window for Ventilation (*window*)	
Advantage	Dis-advantage	Advantage	Dis-advantage	Advantage	Dis-advantage	Advantage	Dis-advantage
Quickest route to the scene of a fire	High likelihood for backdraft – unsafe for victims and firefighters	Reduces odds of backdraft - lowering risk for firefighters and victims	Moderately labor and time intensive	Reduces odds of backdraft - lowering risk for firefighters and victims	Extremely labor and time intensive	Relatively quick and little labor demand	Increased potential for backdraft – unsafe for victims and firefighters
A line between victim and fire improves victim's odds for survival	Very risky operations for firefighters		May do nothing to improve victims' odds for survival	Very low risk for firefighters	May do nothing to improve victims' odds for survival	Improves visibility for firefighters and victims caught in a smoke filled atmosphere	
			The roof of a structure fire is potentially unsafe for firefighters				

As seen above, many factors weigh into potential final choice selection, resulting in a complex and challenging decision task. If a participant chooses to review only a portion of the information available, a clear-cut *optimal* answer could be any of the choices. Because individuals make alternative selections by trading off their relative advantages and disadvantages (Payne, et al., 1993), the goal is to examine whether the addition of potential victims (*high* versus *low* tradeoff) leads to a shift in final choice distribution between participants. *Window* was the most frequent response for both high (~52%) and low (~45%) tradeoff groups. The frequency of differentiation between the groups suggests that tradeoff had little impact on final choice distribution. In fact, a Pearson's chi-square analysis revealed no statistically significant relationship between the final choice selections and tradeoff, X^2 (3, N = 62) = 0.74, p = .8638.

Research suggests that the outcome is dependent on the degree to which a decision maker is willing to trade a decrease in accuracy (potentially selecting a less optimal choice) for savings in effort (Payne, et al., 1993). Thus, strategy selection is often a compromise between accuracy and cognitive demand (selecting an accurate option, yet minimizing effort). The strategy offering the best tradeoff of advantages and disadvantages (*window*) was most often selected. It seems in this case, that manipulated tradeoff levels did little to impact decision maker's propensity to select optimal choices.

Time Pressure

Time pressure is assumed whenever the time available for a task is perceived as being shorter than normally required for the activity (MacGregor, 1993; Svenson & Edland, 1987). Bourne and Yaroush (2003) wrote that the "literature contains very little evidence on the effects of time pressure on cognitive performance" (p. 54). Prior research that has addressed the effects of time pressure on choice and process (e.g., Dror, et al., 1999; Ozel, 2001; Payne, et al., 1996) shows that increased time pressure may "exceed the information processing capabilities of even the most motivated decision maker" (Payne, et al., 1993, p. 38).

To further examine time pressure, firefighters were placed in the VRE assuming the position of company officer located inside of a structure on fire. Conditions encountered were indicative of an early development fire progressing towards flashover. Flashover is a rapidly-occurring transitional event, where a significant increase in fire growth from a particular source of burning rapidly progresses to the ultimate burning of virtually every other exposed combustible fuel surface (National Fire Protection Association, 2004). The scene encountered provided the firefighters with cues that this pre-flashover condition would progress to flashover (e.g., fire in an enclosed point of origin, dense stratified smoke with rapid development from the ceiling level downward, fire rollover from room of origin). Time pressure was manipulated by altering the time it takes the smoke to accumulate from the ceiling to the floor. In the low time pressure, this time period was set to three minutes. In the high time pressure the time period was set to one minute, suggested by Klein (1998) as the cutoff for high time pressure. The longer a participant took in assessing the situation or reviewing information, the more visibility was lost to the accumulating smoke and the potential of a flashover increased. To emphasize the difference between one and three minutes as a different time pressuring mechanism, the time from an initial room fire to a complete engulfment of the compartment (flashover) is five minutes on average. Thus, one and three minutes should be significantly different as time stressors for firefighters.

The Effect of Time Pressure on Time to Decision

Time pressure had a significant impact on decision-making characteristics. Research suggests that when time pressure increases, decision makers first attempt to accelerate information processing (Payne, et al., 1988) and that as time pressure increases, the amount of time spent processing information decreases substantially (Ben-Zur & Breznitz, 1981). Overall, across all participants (N = 62) the average time to decision was 79.86 seconds (SD = 63.82). The results showed that the time to decision decreased significantly, $t(60) = 1.59$, $p = .0583$, under high time pressure (M = 67.11 seconds, SD = 56.38) compared to low time pressure (M = 92.61 seconds, SD = 69.05; see analysis for hypothesis H13). These results are consistent with Ben Zur and Breznitz' (1981) theory that suggests that when time pressure goes up, time spent processing information goes down. Thus, in the event there is no possibility to process information any faster, the decision maker resorts to a higher level of selectivity.

The Effect of Time Pressure on Information Processed

Easterbrook (1959) found that when under time pressure, decision makers tend to focus more on what they believe to be critical information, while ignoring (what they believe to be) less critical cues. Researchers have also concluded that the greater the pressure to make a choice in a restricted period of time, the less information the decision makers use in making their decisions (Rothstein, 1986; Wright, 1974). Overall, across all participants (N = 62), the average amount of information processed was 2.52 cells (SD =

2.5). It was anticipated that the information processed in the low time pressure group would be greater, as the more time available in the scenario would afford participants the opportunity to review and process more information to make a decision. However, the results from this study did not show, $t(60) = 0.29$, $p = .1825$ (see analysis of hypothesis H14), that the amount of information processed under high time pressure group ($M = 2.23$ SI, $SD = 2.72$) was less than the amount of information processed in the low time pressure group ($M = 2.81$ SI, $SD = 2.27$). These results were unable to confirm prior research which suggests that the greater the pressure to make a choice in a restricted period of time, the less information the decision makers use in making their decisions (Rothstein, 1986). Similarly, Ozel (2001) found that extreme time pressure impeded performance by narrowing the range of information noted and processed. It could be that participants under any level of time pressure were processing only a subset of (what they perceive to be the) the most important information, referred to as filtration (Miller, 1960).

The Effect of Time Pressure on Information Search Patterns

Janis and Mann (1977) suggest that time pressure also leads to a shallower search for information, that is, an increased search across all alternatives and fewer searches in depth of the alternatives. Overall, across all participants ($N = 62$), the average SI was 0.38 ($SD = 0.73$). It was anticipated that the information review pattern in the low time pressure group would be less alternative-based, as increased time pressure is said to result in a more dimensionally-based decision strategy (lower SI). However, the data revealed insignificant differences for the search indices score, $t(60) = 0.65$, $p = .2592$ (see results for hypothesis H15). Information search patterns among the low time pressure group ($M = 0.32$ SI, $SD = 0.68$) were not significantly more alternatively-based than in the high time pressure group ($M = 0.44$ SI, $SD = 0.78$). Inconsistent with the research (Payne, et al., 1993), the positive search indices both in low and high time pressure suggest that participants processed information in a more alternative-based method.

The Effect of Time Pressure on Decision Strategy

Under time pressure, the utilization of a more normative decision strategy may "exceed the information processing capabilities of even the most motivated decision maker" (Payne, et al., 1993, p. 38). Klein (1998) suggests that rational choice strategy is too restrictive and "rarely is there the time or information needed to make this strategy work" (p. 29). Which decision strategies are most optimal for occupations—such as firefighting—that require numerous tasks under a highly time-pressurized environment?

Klein (1998) maintains that with the RPD model, decisions under severe time pressure (less than one minute) are habitual or intuitively non-analytic, generally using the singular evaluation strategy discussed previously. It is important to stress that his work is based on interview protocols conducted with firefighters after the decision-making process occurred. Decision makers, when faced with time pressure may take a step-by-step process in coping with increasingly more severe time pressure. First among these steps is an attempt to speed up the information processing. When time pressure increases and it is not possible to process information any faster, the decision maker resorts to a higher level of selectivity. When the time becomes extremely short, the decision maker may then choose to change decision strategies in coping with the situation (Ben-Zur & Breznitz, 1981; Janis & Mann, 1977; Miller, 1960). At the extreme, this could involve utilizing random decision selection (RAN) or shifting from a compensatory to non-compensatory decision rule.

The results from this study (utilizing a VRE to study decisions made under time pressure as the decisions are being made) yield similar findings but not to the extent reported by Klein, Calderwood, and Clinton-Cirocco (2010) who report 80% of firefighters utilize RPD. The data for this research yield that approximately 55% of participants under low time pressure and approximately 48% of those under high time pressure utilized RPD. Klein (1998) asserted that regardless of the time pressure involved, RPD could be used by those with expertise as an efficient decision strategy. This research substantiates that claim, in that nearly half of all participants utilized this decision strategy.

Payne, et al. (1988) found that decision makers, in attempts to reduce the cognitive load, use strategies that review some information on all alternatives (e.g., elimination by aspect and lexicographic). Research suggests that these cognitive shortcuts lead to improved accuracy under time pressure (Payne, Johnson, Bettman, & Coupey, 1990). The data revealed that under low time pressure ~23% of participants utilized EBA, while ~10% of particpants utilized DE. Under high time pressure, only approximently 7% of particpants utilized DE and ~10% utilized EBA. The frequency of particpants that utilized congitive shortcuts under time pressure, unlike how the literature suggests, did not increase. Rather, participants in the high time pressure scenario utilized more purely alternative-based decision strategies (SAT, RPD, MCD), and less EBA, a purely dimensionally-based strategy. This may support Zakay's (1993) model, where under time constraints, the decision maker automatically allocates resources to monitor time, and by doing so reduces the mental resources available to elevate decision-making quality. A Pearson's chi-square analysis revealed no statistically significant relationship between decision strategies and time pressure, X^2 (6, N = 62) = 4.43, p = .6194.

The Effect of Time Pressure on Final Choice

Firefighters often find themselves inside a burning structure. It may be difficult to comprehend the level of time pressure experienced by a firefighter as the heat builds and the visibility decreases. Decisions need to be made at a rapid pace; prolonged deliberation can result in catastrophic outcomes. Fire growth occurs exponentially; that is, fire doubles in size with each second of free burn allowed (Environmental Systems Research Institute , 2007). Because fire growth can expand at a rate of many times its volume *per* minute, time is the critical factor for the application of water and potential rescue of occupants. Too long of a delay can result in reduced potential for savable victims and increased possibility for flashover within minutes after free-burn starts. Thus, selecting a final choice for this pre-flashover scenario is critical to the safety of both victims and firefighters.

By altering the rate of accumulation of smoke, the time pressure scenario proved challenging in determining a final choice. The firefighter could select one of four options, a) attack the fire (*attack*); b) cool the environment by flowing a fog pattern of water in the structure (*cool*); c) back out of the structure (*back out*); or d) break a window for horizontal ventilation (*window*). Table 67 explains the potential conflicting dimensions that a firefighter must consider in deciding whether to; extinguish the fire, improve the conditions in the house, or evacuate without extinguishment or potential to rescue prospective victims. It can be seen, that with each choice, a participant faces the scrutiny of having both optimal and suboptimal dimension evaluation on dimensions.

Table 67: Optimality of Final Choice

Attack the Fire (*attack*)		Cool the Environment (*cool*)		Back Out of the Structure (*back out*)		Break a Window for Ventilation (*window*)	
Advantage	Dis-advantage	Advantage	Dis-advantage	Advantage	Dis-advantage	Advantage	Dis-advantage
A quick fire “knockdown” can decrease both firefighter’s and victim’s odds of encountering a flashover	Delays from attack increase likelihood for flashover – unsafe for victims and firefighters	Reduces odds of flashover - lowering risk for firefighters and victims	May do nothing to improve victims' odds for survival	Reduces odds of firefighters being caught in a flashover	If fire doubles in size exponentially, there is little time to waste	Relatively quick and little labor demand	May do nothing to improve victims' odds for survival
A line between victim and fire improves victim’s odds for survival	Prolongs search and rescue, unless performed by another crew	Reduces the high temperature conditions	May disrupt the thermal layering of smoke, reducing visibility	Very low risk for firefighters	Does nothing to improve victims' odds for survival	Improves visibility for firefighters and victims caught in a smoke filled atmosphere	
		Quick and easy to perform	May cause steam burns to anyone without proper protection			Reduces the high temperature conditions	

Many factors weigh into each selection, resulting in a complex and challenging decision task. If a participant chooses to review only a portion of the information available, their perception may be that a clear-cut *optimal* answer could be any of the choices. However, if someone were to take the time and gather all available information (in this case, by processing all the available informational cells), the most seemingly advantageous answer is to *attack* the fire, but to do so expeditiously. If a participant were to spend too long in the pursuit of information, conditions deteriorate rapidly, and *back out* may be the firefighter's only safe option. The data showed that approximately 55% of participants under low time pressure and approximately 52% of those under high time pressure selected to *attack* the fire. However, a Pearson's chi-square analysis revealed no statistically significant relationship between final choice selection and time pressure, X^2 (3, N = 62) = 1.57, p = .6658.

It's interesting to note the higher frequency of *back out* as a final choice under low time pressure. Nearly a third of the participants (~32%) under low time pressure selected to back out of the fire, while only approximately 13% of those under high time pressure selected this option. This seems inconsistent to what Ozel (2001) suggested; that extreme time pressure impeded performance by narrowing the range of environmental cues noted and processed. Because fire growth can expand at a rate of many times its volume per minute, time is the critical factor for the application of water and the potential rescue of occupants. To back out of the fire will not alleviate the concern for occupant rescue. Participants under high time pressure made quicker decisions overall, which may have caused them to be less likely to feel rushed into the decision to *back out*. Or it could be that participants under high time pressure did in fact miss environmental cues. When they should have selected *back out* as their option, failure to recognize the rapidly changing conditions caused them to select a less optimal (for their safety) choice, which could be an example of the devastating effect that stress has on decision makers.

Physiological Response

According to Beattie & Barlas (2001), stress can influence decision strategy and judgments. Blascovich and Tomaka (1996) presented a framework that differentiates challenge stress from threat-stress states. Challenge stress is a state in which an individual feels he or she has the appropriate mental capacity to deal with the situation, as opposed to threat-stress state, where they do not (see also Frankenhaeuser, 1986; Henry, 1980).

Mendes et al. (2007) showed that these two stress states have different cardiovascular signatures. Challenge-related stress results in an increased cardiac output and a reduction in the total peripheral resistance, to allow increased blood volume to the periphery and increased rate of blood flow to the brain and muscles. In contrast, a threat state presents a cardiovascular profile with reduced efficiency and increased vasculature resistance.

To test for stress in these experiments, changes in heart rate and blood pressure were compared, as described in the Methodology chapter.

The Effect of Tradeoff on Physiological Response

It was anticipated that under low tradeoff, the results from the physiological data would show responses more typical of challenge-related stress (increase in heart rate, but a stable or decreasing blood pressure). However, the analysis showed that stress in the low tradeoff group was not significantly more challenge-related, nor threat-related, than stress in the high tradeoff group (see results for hypothesis H4). These results potentially suggest that both scenarios were equally challenging or threatening to the participants.

The Effect of Time Pressure on Physiological Response

It was anticipated that under low time pressure, the results would show responses more typical of challenge-related stress (increase in heart rate, but a stable or decreasing blood pressure). The data revealed a significant difference for the normalized maximum change in HR yield, $t(59) = 1.92$, $p = .0301$ (see results for hypotheses H16), indicating a higher cardiac output under low time pressure ($M = 70.05$ BPM, $SD = 62.70$), compared to high time pressure ($M = 43.91$ BPM, $SD = 42.20$). As expected, participants under low time pressure demonstrated cardiovascular profiles that are more typical to challenge-related stress than profiles under the high time pressure condition.

The Effect of Experience on Physiological Response

The expectation was that veterans (while in the tradeoff scenario) would demonstrate a cardiovascular profile that is more typical to challenge-related stress than novices when stressors are present. Participants under low tradeoff did not demonstrate cardiovascular profiles that were more typical to challenge-related stress than these profiles under the high tradeoff condition. The results were counter intuitive (see analysis for hypothesis H8). The intuitive expectation that novices will be more threatened than veterans was violated. The insignificant difference in change in HR between the novices and the veterans and the significantly higher changes in maximum BP $t(59) = 2.18$, $p = .0167$, indicate that veterans ($M = 58.90$ systolic, $SD = 34.08$) are more threatened by the scenario than novices ($M = 42.73$ systolic, $SD = 12.90$). Potentially, this could be because veterans better understand the significance of the scenario and the severity of the consequences. The results indicated that there was no significant difference between the type of stress that novices and veterans experienced (see analysis for hypothesis H20).

Experience

Experience was examined as a continuous variable in relationship to dependent variables (e.g., time-to-decision, SI, information processed, etc.). The results indicated very low associations with these variables. For example, in Experiment 1, the association between experience as a continuous variable and time to decision was at a level of $r^2 = .04$ between these two. In Experiment 2, experience and SI yield $r^2 = .01$. For other combinations, results varied in between this range. Thus, employing experience as a continuous variable was not an appropriate option. The question was then, how should experience be classified?

Orasanu and Connelly (1993), wrote that “relatively little research has been done on the role of expertise in decision making” (p. 11). However, understanding how people use their knowledge and experience in coping with complex decision tasks, could help explain the fundamental differences between novices and veterans. For firefighters, understanding these differences is critical; as Foley (2003)suggested that a decline in experience necessary on the fire ground could be partly to blame or the increasing firefighter death rates. Hintze (2008) assures that firefighters with experience are better able to predict fire behavior and make safer decisions.

Camerer and Johnson (1991) suggest that an “expert is a person who is experienced at making predictions in a domain and has some professional and social credentials” (p. 196). However, for these experiments (where experience varied from 1 to 26 years), it was necessary to create a cutoff amount of years to distinguish between novice and veteran. Thus, subjects with 10 years or more experience were considered veterans, while the novice group consisted of firefighters with less than 10 years of experience. This number was far from arbitrary, as the participants’ history with fire behavior attests. For novices, only approximately 13% had previously encountered a flashover, while none had ever encountered a backdraft. On the other hand, approximately 36% and 26% of veterans had previously encountered a flashover and backdraft, respectively.

When one considers the tremendous amount of information needed to obtain significant knowledge of fire behavior and the enormity of factors associated with this behavior and the appropriate response, 10 years becomes an appropriate cutoff. In fact, Ericsson and Charness (1994) concurred, in that expertise can be gained only from performing a task for 4 hours/day, 6-7 days/week, for about 10 years! Hutton and Klein (1999) also propose that it takes some firefighters 10-15 years to gain a satisfactory level of expertise.

The Effect of Experience on Time to Decision

In Experiment 1, experience was an important factor in decision strategy and final choice, and there were several findings worth noting. Overall, across all novice and veteran participants (N = 62), the average time to decision was 203.35 seconds (SD = 88.64). It was anticipated that time to decision in the novice group would be longer, as veterans are expected to make more expedient decisions. Results showed there was a moderately significant difference, $t(60) = 3.02$, $p = .0874$ (see analysis for hypothesis H5). However, it was not the novices (M = 178.29 seconds, SD = 78.17) that took longer to make a decision, but rather the veterans (M = 218.13 seconds, SD = 92.03). Potential explanation for the extended judgment process by veterans is that veterans are more tuned or sensitive to slight changes in the scene. Therefore, they may be able to better predict when the situation may be or become adverse; thus, allowing themselves maximum time for enhanced assessment of the decision task. This alternative explanation should be addressed in further experiments.

Results for Experiment 2 showed no significant difference, $t(60) = 1.22$, $p = .1137$ (see analysis of hypothesis H17), between veterans and novices. The time to decision among veterans ($M = 87.42$ seconds, $SD = 76.07$) was not significantly longer than the time to decision among novices ($M = 67.04$ seconds, $SD = 32.04$). These results were not expected and were contrary to the literature, which suggests that experienced people are able to generate quicker decisions (Kobus, et al., 2000; Warwick, et al., 2001), and that novices, lacking this experience show the reverse trend. Novices were said to spend less time on the dynamics of the situation and more determining how to respond, thus taking longer to reach a decision. Veteran decision makers may have also utilized a variation of RPD, which occurs when one devotes more attention to gathering additional information, in order to better diagnose the situation (Klein G. , 1993).

The Effect of Experience on Information Processed

For both experiments it was anticipated that the amount of information processed in the novice experience group would be greater, as veterans' abilities to recognize the situation, either from prior knowledge or expertise, would lead to extremely expedient decision-making (Warwick, et al., 2001). Overall, across all novice and veteran participants ($N = 62$) for Experiment 1, the average amount of information processed was 6.61 cells ($SD = 4.98$). However, the amount of information processed among the novice group ($M = 6.00$ cells, $SD = 5.23$) was not greater than the amount of information processed in the veteran group, $t(60) = 0.74$, $p = .2305$ ($M = 6.87$ cells, $SD = 4.85$; see analysis for hypothesis H6). It is unclear why, despite the significantly longer time-to-decision by veterans, the amount of information processed did not vary be experience level. It is possible that veterans, while interacting with the decision matrix, took "breaks" from the matrix to further evaluate the scene in light of information acquired from the matrix. Unfortunately, the after action review algorithm of VirtuTrace™ was not completed yet, to allow repeated reviews of the firefighter journey in the scene scenario. This phenomenon requires further investigation.

Overall for Experiment 2, across all novice and veteran participants (*N* = 62), the average amount of information processed (see analysis for hypothesis H18) was 2.52 cells (*SD* = 2.50). The difference between the amount of information processed for the novice (*M* = 2.04 cells, *SD* = 1.89) and veteran groups (*M* = 2.79 cells, *SD* = 2.78) was insignificant, *t*(60) = 1.14, *p* = .1282). The amount of information searched was not affected by experience. It is unknown which factors may help explain why novice decision makers did not process more information, but it is possible that they did not comprehend the situation to the level of understanding to realize that more information may have been useful.

The Effect of Experience on Information Search Patterns

For both experiments, it was anticipated that SI (Billings & Scherer, 1988) in the novice group would be lower, as lack of expertise may lead participants towards less cognitively-demanding (dimension-based) review patterns. Overall for Experiment 1, across all novice and veteran participants (*N* = 62), the average SI was 0.09 (*SD* = 0.69). Information search patterns (see analysis for hypothesis H7) among novices (*M* = -0.18 SI, *SD* = 0.69) was significantly, *t*(60) = 2.53, *p* = .0071, less alternative-based than the patterns in the veteran group (*M* = 0.26 SI, *SD* = 0.64), indicating a more analytical review by veterans.

Overall for Experiment 2, across all novice and veteran participants (*N* = 62), the average SI was 0.38 (*SD* = 0.73). The information search pattern (see analysis for hypothesis H19) among the novice group (*M* = 0.25 SI, *SD* = 0.82) was not significantly, *t*(60) = 1.12, *p* = .1342, less alternative-based than the information search patterns in the veteran group (*M* = 0.46 SI, *SD* = 0.66). Again, dimensional-based decision making is said to be less cognitively demanding (Russo & Dosher, 1983), thus novice participants would be expected to be more engaged with this mode. Novices are expected to struggle with recognition of pattern matching, multiple cues, or the correlation of pragmatic information with key observations

(Klein G. , 1993). Thus, negative SI scores for Experiment 1 met expectations that suggested novices tend to employ a less analytical approach (Larkin, et al., 1980).

The Effect of Experience on Decision Strategy

For Experiment 1, a Pearson's chi-square analysis revealed no statistically significant relationship between the decision strategy distribution and experience, X^2 (8, N = 62) = 6.69, p = .5701. However, more veteran participants utilized the alternative-based decision strategy of RPD (n = 6, ~15%), versus novices (~9%). Similar to Klein's (1998) suggestion, that RPD would be a strategy used primarily by experienced decision makers, results showed that three out of every four participants utilizing RPD were experienced participants. Of the participants utilizing SAT, approximately 57% were veterans, and more veterans utlilzed randomized decision strategy (RAN) than novices. It is possible that the veteran participants struggled more with the decision and attempted to simplify the task, but were unable to organize a logical decision strategy.

POLI, where dimensional-based review reduces the complexity of the decision tasks prior to shifting to an analytical review of a more simplified decision, was more prevelant among novice participants. Veteran participants were 56% more likely to utilize the alternative-based decision strategy of RPD than novices. Likewise, novice participants were 15% more likely to utilize the decision task simplifying strategy of POLI than veterans.

Distribution of alternatives by strategy orientation is provided below:

- Pure alternative-based (WADD, SAT, and RPD): Veterans ~28%; Novices: ~22%
- Pure dimension-based (LEX, EBA): Veterans ~ 8%; Novices: ~ 8%
- Mixed orientations (POLI2DE, POLI, DE): Veterans ~26%; Novices: ~30%
- No explicit strategy: Veterans ~39%; Novices: ~39%

Research suggests that people have a repertoire of available decision strategies for solving decision tasks that has been acquired through prior experience or formal training (Payne, et al., 1993). Certainly, the above results suggest that prior experience may have been a factor in the selection of a suitable strategy. It has been suggested that when people are faced with a complicated judgment or decision, “they often simplify the task by relying on heuristics or general rules of thumb” (Plous, 1993, p. 107).

RPD version 1, reported as a model of choice most common among the experienced (Klein G. , 1998), was more frequent among veterans. It has been suggested that experience may impact the frequency and recency with which available strategies are accessed and used by a decision maker (Payne, et al., 1993). Based on this suggestion, experienced decision makers may be more likely to utilize RPD even when facing a new and unfamiliar decision task. If this were the case, it stands to reason that veterans may utilize alternative-based strategies (e.g., RPD) more frequently than novices, who showed tendency to utilize mixed strategy (POLI).

For Experiment 2, a Pearson’s chi-square analysis revealed no statistically significant relationship between decision strategy distribution and experience, X^2 (6, N = 62) = 6.21, p = .4001. However, both veteran *and* novice participants utilized the more alternative-based decision strategy of RPD (~49% and ~57%, respectively). Veterans utilized seven different types of decision strategies, while novices were distributed among only four different strategies. Veterans also displayed a preference towards multi-stage strategies, selecting POLI and DE by five times the frequency of novices. Payne, et al. (1993) suggest that as time pressure increases, decision strategies would become more attribute-based, and even expert decision makers would rely more frequently on decision heuristics. Neither novices, nor veterans showed preferences for attribute-based decision strategies (e.g., EBA). There were no novices that utilized SAT, however, approximately 10% (n = 4) of veterans utilized this decision strategy. This suggests that some participants may accept “good enough,” rather than searching for the best alternative (Lai, 2010).

The Effect of Experience on Final Choice

Under the normative model of decision theory, decision makers are assumed to have complete information about the probabilities and consequences attached to each alternative course of action. This theory suggests that decision makers are capable of calculating the advantages and disadvantages of each alternative in order to eventually maximize their utility (Sage, 1990) with the most optimal final choice. Results from these experiments show that under naturalistic conditions, decision makers do not always operate this way.

Under low tradeoff, the scenario cues suggested that there were no potential victims in the home; thus search and rescue was a lower priority for firefighters and speed would do little to affect the outcome. In this case, after identifying the possible signs of a backdraft, firefighters would risk little (firefighter safety) to save property only. Thus, ventilating the structure without placing firefighters on a roof of unknown condition would be an optimal decision (*truck* as final choice). However, results showed this choice to be selected by only one participant under low tradeoff. It could be argued that a final choice that could occur much quicker (although speed was not an issue under low tradeoff) was to break an upper floor *window* to release accumulated heat and gases. But, this is rarely the most optimal selection in real life (e.g., wind direction, closed doors, lack of windows next to the seat of fire). However, this choice was selected most frequently under both low and high tradeoff.

Under high tradeoff, the scenario cues suggested that potential victims were inside the home, thus search and rescue was a high priority. Protecting the victims from additional harm until they could be located and rescued was of primary concern. Thus, firefighters may take additional risks or make tradeoffs on firefighter safety, to rescue a potential victim. In this case, after identifying signs of backdraft, a firefighter would desire to vertically ventilate the roof (*roof* as final choice). Frequency of *roof* as a final selection decreased under high tradeoff by both novices and veterans.

Regardless of tradeoff, selecting to make entry through the front door could be devastating and potentially fatal to both firefighters and victims inside the home. Allowing fresh air to rush in through an open door to an oxygen-starved fire will create rapid explosive-like conditions, called a backdraft. The only effective way to mitigate these conditions is to allow the superheated gases to escape upward through a vertical opening, as directly over the fire as possible. This could be accomplished through breaking a window

(*window*) as high up on the structure as possible, or by vertical ventilation either from the roof (*roof*) or from a truck (*truck*).

For Experiment 1, a Pearson's chi-square analysis revealed a moderately significant relationship between the final choice selections and experience, X^2 (3, N = 62) = 7.75, p = .0573, suggesting that veterans were more likely to select *window* as their final choice. Veterans selected w*indow* at nearly four times the rate of *door*, and *window* at more than three times the rate of novices. Only one participant, a novice, selected *truck*, while other selections were evenly distributed between novices and veterans. Of particular interest, is that although opening a front *door* in this scenario could prove disastrous, there were six veterans and seven novices that selected *door* as their final choice. In fact, *door*, the least optimal selection, was more than twice as likely to be selected by a novice as veteran participant. Russo (1977) suggested that participants do not necessarily compare all the available options, and this appears to be the case. It seems highly unlikely that a veteran firefighter would select *door* as an acceptable option, if they weighed the consequences to firefighters and civilians alike, with the possibility of a potential backdraft. This outcome is contrary to literature that suggests the rational person makes a consistent choice of alternative actions to maximize their expected utility (Sage, 1990). Sage (1990) also suggests that heuristics could result in inferior choice making, which may have been the case for these novices and veterans alike who selected *door* as their final choice.

For the final choice in Experiment 2, a Pearson's chi-square analysis revealed no statistically significant relationship between final choice selection and experience, X^2 (3, N = 62) = 1.84, p = .6073. However, veterans and novices selected *attack* (~49% and ~65%, respectively) more frequently than other choices. Veterans selected the final choices of *back out* (~26%), *cool* (~10%), and *window* (~15%) all more frequently than novices. Hutton and Klein (1999) suggest that veterans do not have to conduct extensive searches for response options due to the vast library of learned responses to typical conditions; and that a veteran's understanding of a problem often leads to a more efficient solution.

Interestingly however, *back out* was selected by more than twice as many veterans as novices. Veterans were found to take more time to reach a decision, thus it is possible that in their prolonged search for the acquisition of information, veterans allowed the conditions to deteriorate. Thus, fire conditions in the room dictated that they *back out* and alter their strategy. This is in contrast to the novice that "jumps right in and begins to manipulate the surface features of the problem" (Hutton & Klein, 1999, p. 34), and finds themselves much more readily apt to immediately *attack* the fire. Herek, Janis, and Huth (1987) suggest that the quality of decision making affects the outcome, which seems to be true in this study.

Tradeoff and Experience

The interaction of both tradeoff and experience was an important factor in decision strategy and final choice, and there were several findings worth noting.

The Effect of Tradeoff and Experience on Time to Decision

Overall, across all novice and veteran participants in low tradeoff (n = 31), the average time to decision was 226.64 seconds (SD = 96.17), and in high tradeoff (n = 31) the average time to decision was 180.07 seconds (SD = 74.87). For novice participants in both high and low tradeoff (n = 23), the average time to decision was 178.29 seconds (SD = 78.17), whereas for veteran participants in both high and low tradeoff (n = 39), the average time to decision was 218.13 seconds (SD = 92.03). It was anticipated that for novice participants under low tradeoff (see analysis for hypothesis H9), time to decision would take longest, as the research suggests that veterans typically make more expedient decisions and cues in the scene indicated a very low likelihood that victims were in the house. The main effects model resulted in $F(2, 59) = 3.34$, $p = .0254$, with both tradeoff, $F(2, 59) = 5.08$, $p = .0281$, and experience, $F(2, 59) = 4.08$, $p = .0371$, found to be statistically significant. Further analysis showed that time to decision by veterans under low tradeoff (LSM = 254.69) was statistically significant, $t(58) = 2.05$, $p = .0449$. Veterans under low tradeoff took the longest time to decision. It is unknown which factors may help explain why novice decision makers took less time to decision than veterans. Veterans may pick up the cues in this scene that indicate a very low likelihood that victims are in the house. Because cues in the tradeoff scenario indicate the relative likelihood of potential victims, it is possible that decision makers may be more apt to confront conflict and utilize decision strategies which can require additional processing effort (Payne, et al., 1993) and take significantly longer to perform (Riedl, et al., 2008).

However, the results indicate that, despite the significantly longer time-to-decision by veterans, the amount of information processed did not vary by experience level. As mentioned earlier, it is possible that veterans, while interacting with the decision matrix, took "breaks" from the matrix to further evaluate the scene in light of information acquired from the matrix. This phenomenon requires further investigation.

The Effect of Tradeoff and Experience on Information Processed

Overall, across all novice and veteran participants in low tradeoff (n = 31), the average amount of information processed was 7.77 cells (SD = 5.74), and in high tradeoff (n = 31) the average amount of information processed was 5.45 cells (SD = 3.83). For novice participants in both low and high tradeoff (n = 23), the average amount of information processed was 6.00 cells (SD = 5.23), whereas for veteran participants in both low and high tradeoff (n = 39), the average information processed was 6.97 cells (SD = 4.85). It was anticipated that the amount of information processed in the novice group under low tradeoff (see analysis for hypothesis H10) would be greatest, because veterans' abilities to perform situation recognition either from prior knowledge or expertise should lead to extremely expedient decision-making (Warwick, et al., 2001). Also, low tradeoff cues should provide participants indications that the potential for viable victim(s) in need of rescue is low. Thus, without the need for victim rescue, participants would allow themselves extra time to review more information.

The main effects model results were $F(2, 59) = 1.70$, $p = .1767$. Under this model, tradeoff, $F(2, 59) = 4.52$, $p = .0377$, was significant, while experience, $F(2, 59) = 1.30$, $p = .2587$, was found to be insignificant, with no significant interaction, $F(2, 59) = 0.44$, $p = .5121$.

However, further analysis revealed that information processed by veterans under low tradeoff (LSM = 8.06) was significantly different, $t(58) = 2.12$, $p = .0381$, from novices under high tradeoff (*LSM* = 3.78). It was not the novices under low tradeoff processed the most information to make a decision, but rather the veteran participants. It is possible that decision tasks requiring increasing levels of tradeoff cause the decision maker to make conflict-confronting compensatory decisions, where they are more willing to tradeoff one condition for another (Payne, et al., 1993). This would allow them to be less thorough in their review process, causing those under high tradeoff to spend less time in the informational processing. This phenomenon requires further investigation.

The Effect of Tradeoff and Experience on Information Search Patterns

Overall, across all novice and veteran participants in low tradeoff (n = 31) the average SI was -0.11 (*SD* = 0.69), while in the high tradeoff (n = 31), the average SI was 0.30 (*SD* = 0.63). Across all novice participants in both low and high tradeoff (n = 23), the average SI was -0.18 (*SD* = 0.69), whereas for all veteran participants (n = 39), the average SI was 0.26 (*SD* = 0.64). It was anticipated that the information search patterns in the novice group under low tradeoff (see analysis for hypothesis H11) would be the least alternative-based for two reasons: 1) A lack of expertise may lead participants towards a less cognitively-demanding, dimension-based review mode (Payne, et al., 1993), and 2) low tradeoff cues to an empty house could lead participants towards the more cognitively-easy dimension-based review method.

The result for the main effects model was $F(2, 59) = 3.73$, p = .0161, with both tradeoff, $F(2, 59) = 4.48$, p = .0386, and experience, $F(2, 59) = 4.62$, p = .0357, found to be significant. There was no significance in the interaction between tradeoff and experience, $F(2, 59) = 0.1324$, p = .7173. Further analysis revealed that information processed by veterans under high tradeoff (*LSM* = 0.39) was significantly, $t(58) = 3.34$, p = .0015, different from novices under low tradeoff (*LSM* = -0.35). As expected novices under low tradeoff were the least alternative-based in their information search patterns. This concurs with research suggesting that the information review pattern in the novice group would be less alternative-based, as lack of expertise may lead participants towards the more cognitively-easy dimension-based review method (Payne, et al., 1993). Dimensional-based decision making is also said to be less cognitively demanding (Russo & Dosher, 1983). Thus participants, regardless of experience level, utilizing this mode may afford themselves more mental horsepower to utilize the non-compensatory decision strategies suggested for low tradeoff scenarios.

The Effect of Tradeoff and Experience on Decision Strategy

A series of Pearson's chi-square analyses revealed no statistically significant relationship between decision strategies and the interaction of tradeoff and experience, X^2 $(16, N = 62) = 15.04$, $p = .5218$. RAN was the most frequent decision strategy utilized, regardless of experience or tradeoff. That veterans utilized RAN at nearly twice the frequency, suggests that the veteran participants may have struggled more with the decision task (also supported with the elevated BP). RAN use decreased in frequency among novices under high tradeoff, but increased among veterans under high tradeoff. Attempts to simplify the task may have failed, and veterans may have been unable to organize a logical decision strategy. DE was utilized by only two novices, both under low tradeoff. Furthermore, DE was the second most frequently-used strategy among veterans, regardless of tradeoff level. Thus, it may be that these veterans started with RPD, and found their expectations unmet after reviewing critical information. At this time, the veterans choose to switch strategies, thus they were classified as DE. RPD was also more frequently used among veterans in both low and high tradeoff. It is important to note that Lipshitz (1993) suggested RPD to be much less likely to be encountered with a lack of expertise (DE begins with RPD, prior to switching to a dimension-based search).

The Effect of Tradeoff and Experience on Final Choice

Under high tradeoff, the scenario cues suggested that potential victims were inside the home, thus search and rescue were a high priority. Protecting the victims from additional harm until they can be located and rescued, were of primary concern. Thus, firefighters may take additional risks or make tradeoffs on firefighter safety to rescue a potential victim. A series of Pearson's chi-square analyses revealed no statistically significant relationship between final choice selection and the interaction of tradeoff and experience, X^2 (6, *N* = 62) = 9.03, *p* = .1719. *Window* was most prevalent among veterans in high tradeoff. The effect likelihood model showed a statistically significant result for final choice and experience, X^2 (3, *N* = 62) = 8.29, *p* = .0404, suggesting that significantly more veterans (*n* = 23) than novices (*n* = 7) selected window as their final choice. Under high tradeoff, both *roof* and *window* increased in frequency as selections by participants utilizing (primarily) alternative-based decision strategies of SAT and RPD.

Door was most predominant among novices, especially under high tradeoff. To make entry through the front door could be devastating and potentially fatal to both firefighters and victims inside the home. It is important to remember that for pre-backdraft, the only effective way to mitigate these conditions is to allow the superheated gases to escape upward through a vertical opening, as directly over the fire as possible. This could have been accomplished by selecting from any of the other three available options. Participants utilizing RAN had a higher likelihood of selecting *door* as a final choice, than those utilizing other decision strategies.

The Effect of Tradeoff and Experience on Physiological Response

To determine whether tradeoff conditions and experience had statistically significant main effects on physiological response, analysis on the changes of the normalized minimum and maximum HR and BP were conducted (see analysis for hypothesis H12), as described in the Methodology section. Changes in both normalized HR and normalized minimum BP were not significantly affected by tradeoff and experience. However, significant changes (*p* = .0336) occurred in veterans, who had a significantly higher increase in normalized maximum BP (*M* = 65.2 systolic, *SD* = 44.5) than novices (*M* = 42.6 systolic, *SD* = 14.9), potentially indicating more threat-related stress in these veterans. Furthermore, novices' normalized maximum BP in the high tradeoff condition (*M* = 42.9 systolic, *SD* = 9.9) was moderately lower in comparison to the increase in veterans in the high tradeoff conditions (*M* = 54.4 systolic, *SD* = 24.1). The results were contrary to the expectation that veterans would demonstrate a cardiovascular profile that is more typical to challenge-related stress (lower BP, and higher HR) than novices when stressors are present. However, it's important to remember that though these results show statistical significance on an individual level, when Bonferroni correction is applied, none of these results would be statistically significant. This requires further study.

Time Pressure and Experience

The Effect of Time Pressure and Experience on Time to Decision

Overall, across all novice and veteran participants in low time pressure (n = 31), the average time to decision was 92.61 seconds (SD = 69.05), and in high time pressure (n = 31) the average time to decision was 67.11 seconds (SD = 56.38). Across all novice participants in both high and low time pressure (n = 23) the average time to decision was 67.04 seconds (SD = 32.04), whereas for veteran participants (n = 39) the average time to decision was 87.42 seconds (SD = 76.07). It was anticipated that time to decision for the novice group under low time pressure would be the longest because cues in the scene indicated that more time is available; veterans are expected to make more expedient decisions, and research suggests that as time pressure increases, the amount of time spent processing information decreases substantially (Ben-Zur & Breznitz, 1981).

The main effects model results were insignificant, $F(2, 59) = 1.96$, $p = .1301$, while neither time pressure, $F(2, 59) = 2.28$, $p = .1367$, nor experience, $F(2, 59) = 2.07$, $p = .1557$, were significant. There was also no significance in the time to decision when analyzing for an interaction of time pressure and experience, $F(2, 59) = 0.9359$, $p = .3374$.

Additional analysis revealed statistically significant results, $t(58) = 2.05$, $p = .0449$, between the time to decision by veterans under low time pressure (LSM = 110.75), and veterans under high time pressure (LSM = 69.40). It was not the novices that took longer to make a decision, but rather the veteran participants. As presented before with regard to time pressure, it is possible that the veterans utilized the first variation of RPD, which occurs when one devotes more attention to gathering additional information, in order to better diagnose the situation (Klein G. , 1993). This may have forced veterans to spend relatively more time analyzing a situation than deliberating about a course of action (Kobus, et al., 2000). The additional effort spent looking for unintended consequences that added significant time to their decision task was tolerated by veterans, who may have recognized the low time pressure situation and determined that the decision task could be made with an enhanced deliberation. Veterans may have also realized that due to the relative slow rate of the smoke accumulation in the low time pressure scenario, they were afforded more time to analyze a situation (Kobus, et al., 2000).

The Effect of Time Pressure and Experience on Information Processed

Overall, across all novice and veteran participants in low time pressure (n = 31), the average amount of information processed was 2.81 cells (SD = 2.27), and in high time pressure (n = 31) the average amount of information processed was 2.23 cells (SD = 2.72). Across all novice participants in both low and high time pressure (n = 23), the average amount of information processed was 2.04 cells (SD = 1.89), whereas for veteran participants (n = 39) the average amount of information processed was 2.79 cells (SD = 2.78). It was anticipated that the amount of information processed in the novice group under low time pressure would be the longest because veterans' abilities to perform situation recognition either from prior knowledge or expertise should lead to extremely expedient decision-making (Warwick, et al., 2001), and the greater the time available, the more it will allow reviewing and processing a larger amount of information.

The main effects model yielded the following results, $F(2, 59) = 0.94$, $p = .4263$, with both time pressure, $F(2, 59) = 1.49$, $p = .2279$, and experience, $F(2, 59) = 1.83$, $p = .1809$, insignificant. There was also no significance in the information processed when analyzing for an interaction of time pressure and experience, $F(2, 59) = 0.27$, $p = .6044$.

Further analysis revealed insignificant differences between information processed among groups. Janis and Mann (1977) suggest that increased time pressure leads to a shallower search for information; however the results do not show this to be the case. This phenomenon requires further analysis.

The Effect of Time Pressure and Experience on Information Search Patterns

Overall, across all novice and veteran participants in low time pressure (n = 31), the average SI was 0.32 (SD = 0.68), while in the high time pressure (n = 31) the average SI was

0.44 (*SD* = 0.78). Across all novice participants in both low and high time pressure (*n* = 23), the average SI was 0.25 (*SD* = 0.82), whereas for all veteran participants (*n* = 39), the average SI was 0.46 (*SD* =0.66). It was anticipated that the information search patterns in the novice group under high time pressure would be the least alternative-based because a lack of expertise may lead participants towards a less cognitively-demanding, dimension-based, review mode (Payne, et al., 1993), and increased time pressure is said to result in a more dimensional-based decision strategy (lower SI).

The main effects model yielded results of $F(2, 59) = 0.4767$, $p = .6997$, with neither time pressure, $F(2, 59) = 0.20$, $p = .6596$, nor experience, $F(2, 59) = 1.01$, $p = .3190$, found to be significant. There was also no significance in the information search patterns when analyzing for an interaction of time pressure and experience, $F(2, 59) = 0.00$, $p = .9799$. Further analysis revealed no statistical difference between information search patterns among groups. Contrary to what was expected, novice participants in both the high and low time pressure scenarios did not process information in a more dimensionally-based method. These results appear contrary to Russo and Dosher's (1983) theory that dimensional-based decision making is less cognitively demanding and novice participants are more comfortable with this method, and Payne, et al. (1993) theorize that increased time pressure would result in a more attribute-based decision strategy. This phenomenon requires additional research.

The Effect of Time Pressure and Experience on Decision Strategy

A series of Pearson's chi-square analyses revealed no statistically significant relationship between decision strategies and the interaction of time pressure and experience, X^2 (12, $N = 62$) = 13.48, $p = .3350$. However, RPD was more prevalent among both novices and veterans in high time pressure. This concurs with research that suggests that the recognition-primed decision (RPD) model is how experienced people can make rapid decisions (Klein, et al., 1986). It has been suggested that recognitional-based strategies are the most frequent for experienced decision makers, even for routine decisions, and that analytical strategies are more frequently used by decision makers with less experience (Klein G. , 1993). Certainly the analysis shows that RPD was in fact, the most frequent decision strategy selected, regardless of time pressure or experience level. Furthermore, the use of RPD as a decision strategy actually increased in frequency from veterans to novices. Klein (1993) suggested that those with less experience might utilize analytical strategies (e.g., WADD) more frequently. The data failed to show that novice decision makers had more propensities towards analytical strategies. Novice participants did increase in the use of EBA however; considered a "partial rationality in processing," or decision heuristic (Payne, et al., 1993, p. 27).

The Effect of Time Pressure and Experience on Final Choice

For this scenario, a series of Pearson's chi-square analysis revealed no statistically significant relationship between final choice selection and the interaction of time pressure and experience, X^2 (6, N = 62) = 3.80, p = .7043. However, *attack* was most prevalent among veterans and novices, regardless of time pressure. *Back out* was more prevalent in low time pressure, and by veterans at twice the frequency of novices. *Window* remained a second or third level option regardless of time pressure or experience level. Useem, et al. (2005) suggested that the absence of preparatory experience weakens a capacity for making effective decisions. However, under high time pressure, no novices chose to *back out*, while approximately 14% of veterans did. This is in comparison to the 78% of novices and 50% of veterans that selected to *attack* the fire. Furthermore, it was the novice group that seemed to best recognize the scenario; however, the lack of experience with dealing with the scenario may have led to avoiding *back out* as an option. Of interest, is that while no novices misidentified the scenario under low time pressure, four (~18%) veterans misidentified the scenario. The results were very similar under high time pressure, where again none of the novices misidentified the scenario and two (~12%) veterans did.

The data analysis and results suggest that experience is a critical factor in decision making. However, consistent with this study, much controversy still exists over whether those with expertise always outperform non-experts and always make the correct decision in pressure scenarios (Dawes, et al., 1989). Research appears conclusive that there are pronounced differences between veterans and novices, and situation recognition either from prior knowledge or expertise does not necessarily lead to expedient decision-making.

As referrred to earlier, veterans were found to take more time to reach a decision. Thus, it is possible that in their prolonged search for the acquisition of information, veterans allowed the conditions to deteriorate, regardless of time pressure. Therefore, fire conditions in the room dictated that they *back out* as their strategy. In contrast, the novice "jumps right in and begins to manipulate the surface features of the problem" (Hutton & Klein, 1999, p. 34), and may be more apt to immediately *attack* the fire.

The Effect of Time Pressure and Experience on Physiological Response

Analysis for the effects of time pressure conditions and physiological response yielded no statistical significance in changes of normalized minimum and maximum HR and BP (see analysis for hypothesis H24). Further examination is required for understanding the relationship between time pressure level and the corresponding stress. Appendix I provides a summary of normalized physiological responses.

CHAPTER 7: SUMMARY, LIMITATIONS, AND RECOMMENDATIONS

Firefighting is an inherently dangerous occupation, with an average of more than 100 fatalities and 85,000 injuries in the United States annually (National Fallen Firefighter Foundation, 2005). Poor decision making may contribute to this high prevalence, thus the objectives of this study were to identify the relationships among firefighter experience and decision-making processes, and to determine the relationship between acute stress and these processes in firefighters. Vast literature exists on decision making. However, there are still significant gaps in the knowledge. The overriding goal of this research was to determine the relationships among difficult tradeoff levels, time pressure, experience levels, physiological stress and the decision making processes of firefighters. Broadly, the research questions asked:

1. What are the effects of tradeoff values on decision-making characteristics in firefighters?
2. What are the effects of time pressure on decision-making characteristics in firefighters?
3. What are the associations of physiological responses to stress with firefighter decision making?
4. What are the effects of experience on firefighter decision making?

Utilizing the highest resolution computerized virtual reality system in the world; firefighters were exposed to life-like scenarios varying in the stressors of time pressure and tradeoff values. Decision-making processes and final decision choice were assessed in real-time, and cardiovascular activity was used to characterize participants' stress state. The following general conclusions from this work emphasize several main points:

- Tradeoff
    - Two new decision strategies were discovered: diminished expectations (DE) and poliheuristic to diminished expectations (POLI2DE).

- When tradeoffs were high,
  - participants took significantly less time to reach a decision;
  - participants processed less information to make their final decision;
  - search review processes were significantly more alternative-based; and
  - participants frequently utilized RAN and RPD.
- When tradeoffs were low, participants frequently utilized WADD, LEX, and POLI.

- Time Pressure
  - When time pressure was high, the time to decision decreased significantly.
  - Approximately 55% of participants utilized RPD when time pressure was low and approximately 48% when time pressure was high.
  - Approximately 55% of participants selected to *attack* the fire when time pressure was low and approximately 52% when time pressure was high.
  - When time pressure was low, nearly a third of the participants (~32%) selected to *back out* of the fire.

- Physiological responses to stress
  - High time pressure may be perceived less as a challenge-related task than in the low time pressure condition.

- Experience
  - Veterans' time to decision was longer (moderately significant) than for novices (Experiment 1).
  - Novices utilized dimension-based information search pattern more frequently than veterans (Experiment 1).

  - Veteran participants utilized more alternative-based decision strategies than novices (Experiment 1).
  - Veteran *and* novice participants utilized the more alternative-based decision strategy of RPD in time pressure scenarios (Experiment 2).
  - Randomized decision strategy (RAN) was a frequently-utilized decision strategy among both novice and veteran participants (Experiment 1).
  - *Door*, the least optimal selection, was more than twice as likely to be selected by a novice as by a veteran participant (Experiment 1).
  - *Back out* was selected by more than twice the number of veterans as by novices (Experiment 1).
  - Veterans selected *window* at three times the rate of novices in Experiment 1 (moderate significance).

- Tradeoff by Experience
  - Veterans under low tradeoff took significantly longer to reach a decision than other groups.
  - Veterans under low tradeoff processed significantly more information than novices under high tradeoff.
  - When tradeoff was high, veterans reviewed information in significantly more alternative-based patterns than novices in low tradeoff.
  - RAN was the most frequent decision strategy utilized, regardless of experience or tradeoff.
  - DE was utilized by only two novices, both under low tradeoff.
  - DE was the second most frequent decision strategy among veterans, regardless of tradeoff level.
  - RPD was more frequently used among veterans in both low and high tradeoff.

  - *Door,* the least optimal final choice, was selected most frequently among novices under high tradeoff.

- Time Pressure by Experience
  - Veterans under low time pressure took significantly longer to reach a decision than novices under high time pressure.
  - Novices best recognized the scenario, in that none of them misidentified the scenario under both low and high time pressure.

Limitations

Several limitations to this study are acknowledged. The small sample size was cross-sectional and from a limited number of fire departments. Data was only collected from one industry (i.e., career fire service), and one region of the United States (i.e., mid-central Iowa). The small sample size was due in part to the multi-step, complex, and time-consuming process. Many of the participants were on-duty (currently on the clock, in regards to pay) and still responsible for emergency response, should the need arise for them to leave. The complexity of the study led to an Experiment duration of 90 to 120 minutes per participant.

Although specific directions were orally provided to each participant, some participants may have failed to understand the directions or some may have chosen not to ask clarifying questions, creating the potential for measurement error. The researcher was not always immediately present while the participants completed the questionnaires, so it is assumed, but not guaranteed, that all parts of the data instruments were completed independently. As with all human research, the assumption is that participants responded honestly and thoughtfully to all survey questions and decision scenarios. While participants, by their decision selection were implying that this was the decision choice they would make under these conditions, Murphy (2003) suggests that people don’t always do what they say they are going to do. However, Kahneman and Tversky (1979) wrote in their seminal work on prospect theory:

> The reliance of hypothetical choices raises obvious questions regarding the validity of the method and the generalizability of the results…..The use of the method relies on the assumption that people often know how they would behave in actual situation and choice, and on the further assumption that the subjects have no special reason to disguise their true preference. (p. 278)

Kahneman and Tversky were awarded the Nobel Prize for this work.

Additionally, the survey was computerized, and virtual reality is extremely entwined in moderate computer-savvy skills. However, some of the population in the sample were self-declared *computer illiterates*, and it is unknown if any lack of computer skills may have affected their understanding of the process.

This work was the first attempt at identifying the relationships among tradeoffs, time pressure, stress, and decision making in the fire service environment. Some of the results identified through this work will require further investigation to better understand the phenomena and to validate the outcomes, all ingredients that are essential for confirming theoretical frameworks. In addition, the data collection procedures were relatively new to the participants, introducing potential measurement error. Respondents volunteered for the study, or were volunteered (*volun-told,* so to speak) by their supervisor (e.g., lieutenants, captains, deputy chiefs, or chief), so the possibility of a selection bias cannot be discounted.

In addition, each virtual reality scenario completed by the participant, measured their response to that specific scenario only, and cannot be generalized to other situations and circumstances encountered in the fire service. Research instruments are subject to the normal limitations of using questionnaires and human response data collection. These are limitations and the researcher acknowledges the potential for error they may bring to the conclusions of the study.

Recommendations for Future Work

Surprisingly, few studies exist of how emergency responders make decisions. This was the first research to examine the influence of tradeoff values, time pressure, and experience level on the processes of judgment and decision making in a virtual reality environment. Although it has provided a better understanding of the decision-making processes of firefighters and identified relationships among decision quality and stress levels, it has raised even more questions, as good research efforts often do. Additional recommendations for future readers include:

- Enhance research efforts to further identify relationships among decision quality and stress levels.
- The decision strategies of DE and POLI2DE should be further studied. Additional efforts need to be devoted to either determining how these strategies fit the two variations of recognition-primed decision model or adapt RPD to these new findings.
- While veterans took longer to make decisions under tradeoff scenarios, they also demonstrated more threat-related stressed than novices. Yet, the amount of information processed is not different. This suggests that potentially, veterans utilize more time monitoring the environment. This phenomenon requires further investigation.
- There is a need to further answer several questions in the area of expertise:
    - Are experienced and novice decision makers the only two categories appropriate for the categorization of expertise, or could additional levels of experience be added?
    - Due to the low exposure to real-life backdraft scenarios, the effect of decision making from description vs. decision making from experience should be further studied.
    - Recognition-primed decision making is said to be a strategy primarily for those highly experienced (Klein G., 1998). The use of recognition-primed decision making by firefighters without experience in the area of decision task should be examined more in depth, as the results indicated that

experience did not yield significant difference in use of Klein's (1993) variation 1 of RPD.

- Additional study is needed to determine why when faced with time pressure, all novice firefighters were able to correctly identify the scenario, while several veterans did not.
- The relationship of the dynamics between stress and judgment should be further pursued in an effort to develop an algorithm that can adopt challenge to stress level as a tool for enhancing firefighter performance.
- Utilize VirtuTrace™ to further train the participants and measure its effectiveness as a training tool.

Poor decision making is frequently cited as a major contributing factor to firefighter injuries and fatalities. Stress may affect firefighters' decision making and lead to injuries and deaths of firefighters and civilians. It is hoped that once decision-making processes by firefighters are better understood, and the relationship among decision-making quality, stress, and firefighting experience are identified, decision-making quality may be enhanced. Interventions could lead to the acceleration of the development of expertise in novices. A better understanding of how both novice and veteran firefighters cope with judgment and decision making under high tradeoff and time pressure could potentially save lives. Enhancing emergency responders' decision-making quality will certainly offer tremendous benefit to firefighters, their families, and the public as a whole. This research only begins to reveal what knowledge is needed in these areas, but data collected for this research has established the baseline for further work in this arena.

REFERENCES

Alba, J. W., & Hutchinson, J. W. (1987). Dimensions of consumer expertise. *Journal of Consumer Research, 13*, 411-445.

Anderson, J. (1983). *The architecture of cognition.* Cambridge, MA: Harvard University Press.

Andreassi, J. (2007). *Psychophysiology: Human behavior & physiological response (5th Ed.).* Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Anzai, Y. (1991). Learning and use of representation in physics expertise. In K. Ericsson, & J. Smith (Eds.), *Toward a general theory of expertise: Prospects and limits.* Cambridge, MA: Cambridge University Press.

Ariely, D., & Zakay, D. (2001). A timely account of the role of duration in decision making. *Acta Psychologica, 108* , 187-207.

Ashcraft, M. (2002). Math anxiety: Personal, educational, and cognitive consequences. *Current Directions in Psychological Science, 11*, 181-185.

Ausburn, L. J., & Ausburn, F. B. (2004). Desktop virtual reality: A Powerful new technology for teaching and research in industrial teacher education. *Journal of Industrial Teacher Education, 41:4* .

Ayton, P., Onkal, D., & McReynolds, L. (2011). Effects of ignorance and information on judgments and decisions. *Journal of Judgment and Decision Making*, 381-391.

Azuma, R., Daily, M., & Furmanski, C. (2006). *A Review of time critical decision making models and human cognitive processes.* Malibu, CA: HRL Laboratories, LLC.

Beattie, J. (1988). *Perceived differences in tradeoff difficulty.* Unpublished Ph.D. dissertation, Department of Psychology, University of Pennsylvania.

Beattie, J., & Barlas, S. (2001). Predicting perceived differences in tradeoff difficulty. In E. U. Weber, & G. L. Jonathan Baron, *Conflict and tradeoffs in decision making* (pp. 25-64). Cambridge, UK: Cambridge University Press.

Beattie, J., & Baron, J. (1995). In-kind vs. out-of-kind penalties: Preference and valuation. *Journal of Experimental Psychology: Applied, 1*, 136-151.

Bechara, A., & Damasio, H. (2000). Emotion, decision making, and the orbitofrontal cortex. *Cerebral Cortex, 10(3):* 295-307.

Bell, D., Raiffa, H., & Tversky, A. (1988). Descriptive, normative, and prescriptive interactions in decision making. In D. Bell, H. Raiffa, & A. Tversky (Eds.), *Decision making: Descriptive, normative, and prescriptive interactions* (pp. 9-30). Cambridge, England: Cambridge University Press.

Ben-Zur, H., & Breznitz, S. J. (1981). The effects of time pressure on risky choice behavior. *Acta Psychologica, 47*, 89-104.

Bettman, J. R., & Park, C. W. (1980). Effects of prior knowledge and experience and phase of the choice process on consumer decision processes: A protocol analysis. *Journal of Consumer Research, 7*, 234-248.

Billings, R. S., & Scherer, L. L. (1988). The effects of response mode and importance on decision making strategies: Judgment versus choice. *Organizational Behavior and Human Decision Processes 41*, 1-19.

Blascovich, J., & Tomaka, J. (1996). The biopsychosocial model of arousal regulation. In M. P. Zanna (Ed.), *Advances in social psychology, 28* (pp. 1-51). San Diego, CA: Academic Press.

Bourne, L., & Yaroush, R. (2003). *Stress and cognition: A cognitive psychological perspective.* Washington, D.C.: National Aeronautics and Space Administration.

Brehmer, B. (2000). Dynamic decision making in command and control. In McCann, Pigeau, & Kluwer, *The Human in command: Exploring the modern military experience.* New York, NY: Acedemic/Plenum Publishers.

Brown, R. D. (2001). *Welcome to the world of virtual reality.* Retrieved September 28, 2010, from http://www.crd.rca.ac.uk/staff/richard/vr.html

Camerer, C., & Johnson, E. (1991). The process-performance paradox in expert judgment: How can experts know so much and predict so badly? In K. Ericsson, & J. Smith (Eds.), *Toward a general theory of expertise: Prospects and limits* (pp. 195-217). Cambridge, MA: Cambridge University Press.

Campbell, J., & Austin, S. (2002). Effects of response time deadlines on adults' strategy choices for simple addition. *Memory & Cognition, 30* , 988-994.

Castro, E., Novoselov, K., Morozov, S., Peres, N., Lopes dos Santos, J., Nilsson, J., et al. (2007). Biased bilayer graphene: Semiconductor with a gap tunable by the electric field effect. *Phys. Rev. Lett. 99*.

Chase, W., & Simon, H. (1973). The mind's eye in chess. In W. G. Chase (Ed.), *Visual information processing.* New York, NY: Academic Press.

Chi, M., Feltovich, P., & Glaser, R. (1981). Categorization and representation of physics problems by experts and novices. *Cognitive Science, 5*, 121-152.

Cote, A. E. (2004). *Fundamentals of fire protection.* Quincy, MA: National Fire Protection Agency.

Dawes, R., Faust, D., & Meehl, P. (1989). Clincial versus actuarial judgment. *Science, Vol. 243, No. 4899*, 1668-1674.

de Groot, A. (1965). *Though and choice in chess (2nd ed.).* New York, NY: Mouton (Original work published in 1946).

Department of Agriculture, U. S., & Forest Service, U. S. (2005, June). Fire suppression: Foundational doctrine. *Pulaski Conference*, (pp. 1-21). Alta, UT.

Department of Homeland Security, U. S., & Fire Administration, U. S. (1999, December). *Technical report series: Abandoned cold storage warehouse fatality fire: Worcester, Massachusetts.* Emmitsburg, MD: Federal Emergency Management Agency.

Dillon, S. M. (1998). Descriptive decision making: Comparing theory with practice. *Proceeding of the 33rd Annual Conference of the New Zealand Operational Research Society* (pp. 98-108). New Zealand: New Zealand Operational Research Society.

Dror, I. E., Busemeyer, J. R., & Basola, B. (1999). Decision-making under time pressure: An independent test of sequential sampling models. *Memory & Cognition, 27*, 713-725.

Dunn, V. (2008). *Life and death decision making.* Retrieved November 8, 2009, from http://vincentdunn.com/dunn/newsletter/may/FDNYHP_13.html

Easterbrook, J. (1959). The effect of emotion on cue utilization and the organization of behavior. *Psychological Review, 66*, 187-201.

Edland, A., & Svenson, O. (1993). Judgment and decision making under time pressure. In O. Svenson, & A. J. Maule, *Time pressure and stress in human judgment and decision making* (pp. 27-40). New York, NY: Plenum.

Einhor, H. J., & Hogarth, R. M. (1981). Behavioral decision theory: Process of judgment and choice. *Annual Review of Psychology 32*, 53-88.

Einhorn, H. J., & Hogarth, R. M. (1986). Decision making under ambiguity. *Journal of Business, 59*, 225-250.

Entin, E., & Serfaty, D. (1999). Adaptive team coordination. *Human Factors*, 312-325.

Environmental Systems Research Institute. (2007). *GIS for fire station locations and response protocol.* Redlands, CA: ESRI.

Ericsson, K., & Charness, N. (1994). Expert performance: Its structure and acquisition. *Am Psychol 49(8)*, 725-747.

Ericsson, K., & Simon, H. (1980). Verbal protocols as data. *Psychology Review*, 87, 215-251.

Fahy, R. F., LeBlanc, P. R., & Molis, J. L. (July 2009). *Firefighter fatalities in the United States: 2008.* Quincy, MA: National Fire Protection Association.

Farah, V., Joaquim, L., & Morris, M. (2006). Stress cardiovascular/autonomic interactions in mice. *Physiology & Behavior, 89*, 569-575.

FEMA. (2009, August 13). *National Fire Academy Online*. Retrieved October 22, 2010, from United States Fire Academy, Department of Homeland Security: http://www.usfa.dhs.gov/nfa/nfaonline/browse/im.shtm

Feng, P., Hadjisophocleous, G., & Torvi, D. (2000). *FIERAsystem theory report: A simple correlation model.* Ottawa, ON: Institute for Research in Construction, National Research Council Canada.

Fiedler, F. E. (1992). Time-based measures of leadership experience and organizational performance: A Review of research and a preliminary model. *Leadership Quarterly, 3(10)*, 5-23.

Finucane, M., Alhakami, A., Slovic, P., & Johnson, S. (2000). The affect of heuristic in judgments of risk and benefits. *Journal of Decision Making, 13*, 1-17.

Fishburn, P. (1974). Lexicographic orders, utilities and decision rules: A survey. *Management Science*, 1442-1471.

Flame-Sim. (2010). Retrieved October 5, 2010, from http://www.flame-sim.com/

Fleishmann, C. (1994). *Backdraft phenomena.* Gaithersburg, MD: National Institute of Standards and Technology.

Flin, R., Salas, E., & Martin, M. S. (1997). *Decision making under stress.* Brookfield, VT: Ashgate Publishing Company.

Foley, S. N. (2003). *Resources for fire department ocuupational safety and health.* Quincy, MA: National Fire Protection Association, Inc.

Ford, K. J., Schmitt, N., Schechtman, S. L., Hults, B. M., & Doherty, M. L. (1989). Process tracing methods: Contributions, problems, and neglected research questions. *Organizational Behavior and Human Decision Processes 43*, 75-117.

Frankenhaeuser, M. (1986). A psychobiological framework for research on humans' stress and coping. In M. H. Appley, & R. Trumbull (Eds.), *Dynamics of stress: Physiological, psychological, and social perspectives* (pp. 101-116). New York, NY: Plenum.

Frisch, D., Jones, K., & O'Brien, M. (1992). *What makes decisions difficult?* Eugene, OR: Manuscript: Department of Psychology, University of Oregon.

Gaissmaier, W., & Marewski, J. (2011). Forecasting elections with mere recognition from small, lousy samples: A comparison of collective recognition, wisdom of crowds, and representative polls. *Journal of Judgment and Decision Making*, 73-88.

Gianaros, P., Derbtshire, S., May, J., Siegle, G., Gamalo, M., & Jennings, J. (2005). Anterior cingulate activity correlates with blood pressure during stress. *Psychophysiology, 42*, 627-635.

Gigerenzer, G., & Goldstein, D. (2011). The recognition heuristic: A decade of research. *Judgment and Decision Making, Vol. 6, No. 1*, 100-121.

Gilbert, D. (2002). Inferential correction. In T. Gilovich, D. Griffin, & D. Kahneman, *Heuristics and biases: The psychology of intuitive thought.* New York, NY: Cambridge University Press.

Glockner, A., & Broder, A. (2011). Processing of recognition information and additional cues: A model-based analysis of choice, confidence, and response time. *Journal of Judgment and Decision Making*, 23-42.

Goodrich, A. (2004, October). *Chief reason: Where opinion meets the voice of reason.* Retrieved May 9, 2010, from http://chiefreasonart.com/2009/01/12/interview-with-chief-mark-wessel-of-keokuk-ia-fd/

Gorbett, G., & Hopkins, R. (2007). The current knowledge and training regarding backdraft, flashover, and other rapid fire progression phenomena. *World Safety Conference* (pp. 1-25). Boston, MA: National Fire Protection Association.

Government Technology. (2003, August 19). *News Report: NIST developing virtual reality training tools for firefighters*. Retrieved October 2, 2010, from Government Technology: Solutions for State and Local Government: http://www.govtech.com/public-safety/NIST-Developing-Virtual-Reality-Training-Tool.html

Grimwood, P. (2003). Tactical firefighting: A comprehensive guide to compartment firefighting and live fire training. *Firetactics*, 40-80.

Henry, J. P. (1980). Present concept of stress theory. In E. Usdin, R. Kvetnansky, & I. J. Kopin (Eds.), *Catecholamines and stress: Recent advances up* (pp. 557-571). New York, NY/ North-Holland: Elsevier.

Herek, G., Janis, I., & Huth, P. (1987). Decision making during international crises. Is quality of process related to outcome? *Journal of Conflict Resolution, 31*, 203-226.

Hintze, N. R. (2008). *First responder problem solving and decision making in today's asymmetrical environment.* Monterey, CA: Naval Postgraduate School.

Hoffrage, U. (2011). Recognition judgments and the performance of the recognition heuristic depend on the size of the reference class. *Journal of Judgment and Decision Making*, 23-42.

Hogarth, R. (1975). Decision time as a function of task complexity. In D. Wendt, & C. Viek (Eds.), *Utility, probability, and human decision making* (pp. 321-338). Dordrecht, Holland: Riedel.

Hogarth, R. (1983). *Judgment and choice.* New York, NY: Wiley.

Hogarth, R. (1987). *Judgment and choice: The Psychology of decision (2nd ed).* New York, NY: John Wiley & Sons, Inc.

Horn, C. (2006, November 28). *How experience affects perception in expert decision making.* Retrieved May 16, 2010, from http://www.beefstew.net/downloads/Experience%20in%20Problem%20Solving%20rev2.pdf

Houston, D. A., Sherrill-Mittleman, D., & Weeks, M. (2001). The Enhancement of feature salience in dichotomous choice dilemmas. In E. U. Weber, J. Baro, & G. Loomes, *Conflict and tradeoffs in decision making* (pp. 65-85). Cambridge, UK: Cambridge University Press.

Hutton, R., & Klein, G. (1999). Expert decision making. *System Engineering 2*, 32-45.

Inagaki, H., Kuwahara, M., & Tsubone, H. (2004). Effects of physiological stress on autonomic control of heart in rats. *Experimental Animals 53 (4)*, 373-378.

Iowa State University. (2008). *The C6*. Retrieved December 5, 2010, from Virtual Reality Applications Center: http://www.vrac.iastate.edu/c6.php

Jacoby, J., Chestnut, R., Weigl, K., & Fisher, W. (1976). Pre-purchase information aquisition: Description of a process methodology, research paradigm, and pilot investigation. In B. Anderson (Ed.), *Advances in Consumer Research* (pp. Vol. 3, 306-314). Cincinnati, OH: Association for Consumer Research.

Janis, I. (1982). *Stress, attitude and decisions.* New York, NY: Praeger.

Janis, I. (1983). Decision making under stress. In L. Goldberger, & S. Breznitz (Eds.), *Handbook of stress* (pp. 69-87). New York, NY: The Free Press.

Janis, I., & Mann, L. (1977). *Decision making: A psychological analysis of conflict, choice, and committment.* New York, NY: Free Press.

Jasper, J., & Shapiro, J. (2002). MouseTrace: A better mousetrap for catching decision processes. *Behavior Research Methods, Instruments & Computers*, 34, 364-374.

Just, M., & Carpenter, P. (1976). Eye fixations and cognitive processes. *Cognitive Psychology*, 8, 441-480.

Kahneman, D., & Tversky, A. (1979). Prospect Theory: An analysis of decision making under risk. *Econometrica* , 263-292.

Kahneman, D., & Tversky, A. (1984). Choices, values, and frames. *American Psychologist, 39:4*, 341-350.

Kahneman, D., Knetsch, J. L., & Thaler, R. H. (1991). Anomolies: The Endowment effect, loss aversion, and status quo bias. *The Journal of Economic Perspectives*, 193-206.

Kahneman, D., Slovic, P., & Tversky, A. (1982). *Judgment under uncertainty: Heuristics and biases.* New York, NY: Cambridge University Press.

Kassam, K. S., Koslov, K., & Mendes, W. B. (2009). Decisions under distress: Stress profiles influence anchoring and adjustment. *Psychological Science, 20:11*, 1394-1399.

Keinan, G., & Friedland, N. (1986). Decision making under stress: Scanning of alternatives under physical threat. *Acta Psychologica, 64*, 219-228.

Kellogg, J., Hopko, D., & Ashcraft, M. (1999). The effects of time pressure on arithmatic performance. *Journal of Anxiety Disorders, 13*, 591-600.

Keren, N., Mills, T. R., Freeman, S. A., & Shelley, M. C. (2009). Can level of safety climate predict level of orientation toward safety in a decision making task? *Safety Science*, 1312-1323.

Klayman, J. (1982). *Simulations of six decision strategies: Comparison of search patterns, processing characteristics, and response to task complexity.* Chicago, IL: University of Chicago, Center for Decision Research.

Klein, G. (1993). A recognition-primed decision (RPD) model of rapid decision making. In G. A. Klein, J. Orasanu, R. Calderwood, & C. E. Zsambok (Eds), *Decision making in action: Models and methods* (pp. 138-147). Norwood, CT: Ablex.

Klein, G. (1998). *Sources of power: How people make decisions.* Cambridge, MA: The MIT Press.

Klein, G. (2003). *The Power of intuition.* New York, NY: Doubleday.

Klein, G., & Militello, L. (2004). The knowledge audit as a method for cognitive task analysis. In H. Montgomery, R. Lipshitz, & B. Brehmer (Eds.), *How professionals make decisions.* Mahway, NJ: Lawrence Erlbaum Associates.

Klein, G., Calderwood, R., & Clinton-Cirocco, A. (1986). Rapid decision making on the fire ground. *Proceedings of the Human Factors Society 30th Annual Meeting, 1*, (pp. 576-580).

Klein, G., Calderwood, R., & Clinton-Cirocco, A. (2010). Rapid decision making on the fire ground: The orginal study plus a postscript. *Journal of Congnitive Engineering and Decision Making (4), 3*, 186-209.

Klein, G., Orasanu, J., & Calderwood, R. (1993). *Decision making in action: Models and methods.* Norwood, NJ: Ablex Publishing Co.

Klein, N. (1983). Utility and decision strategies: A second look at the rational decision maker. *Organizational Behavior and Human Performance, 31*, 1-25.

Kobus, D., Proctor, S., Bank, T., & Holste, S. (2000). *Decision-making in a dynamic environment: The effects of experience and information uncertainty.* San Diego, CA: Space and Naval Warfare Systems Center.

Kowalski-Trakofler, K., Vaught, C., & Scharf, T. (2003). Judgment and decision making under stress: An overview for emergency responders. *International Journal of Emergency Management, vol. 1, No. 3* , 278-289.

Lai, L. (2010). Maximizing without difficulty: A modified maximizing scale and its correlates. *Judgment and Decision Making, Vol 5, No. 3*, 164-175.

Langley, P., Simon, H., Bradshaw, G., & Zytkow, J. (1987). *Scientific discovery.* Cambridge, MA: MIT Press.

Larkin, J., McDermott, J., Simon, D., & Simon, H. (1980). Expert and novice performance in solving physics problems. *Science, 20(208)*, 1335-1342.

Laurent, R. (2006). Elimination by aspects and probabilistic choice. *Paris-Jourdan Sciences Economiques*, 1-15.

Lauriola, M., Levin, I. P., & Hart, S. S. (2007). Common and distinct factors in decision making under ambiguity and risk: A psychometric study of individual differences. *Organizational Behavior and Human Decision Processes*, 130–149.

Lesgold, A., Feltovich, P., Glaser, R., & Wang, M. (1981). *The acquisition of perceptual diagnostic skill in radiology (Tech Rep No. PDS-1).* Pittsburgh, PA: University of Pittsburgh, Learning Research and Development Center.

Levin, I., & Jasper, J. (1995). Phased narrowing: A new process tracing method for decision making. *Organizational Behavior and Human Decision Processes*, 64, 1-8.

Lipshitz, R. (1989). *Decision making as argument driven action.* Boston, MA: Boston University Center for Applied Social Science.

Lipshitz, R. (1993). Converging themes in the study of decision making in realistic settings. In G. A. Klein, J. Orasanu, R. Calderwood, & C. E. Zsambok (Eds), *Decision making in actions: Models and methods* (pp. 103-137). Norwood, NJ: Ablex Publshing Corporation.

Lipshitz, R., Klein, G. A., Orasanu, J., & Salas, E. (2001). Focus article: Taking stock in naturalistic decision making. *Journal of Behavioral Decision Making, 14*, 331-352.

Luce, M., Payne, J., & Bettman, J. (2001). The impact of emotional tradeoff difficulty on decision behavior. In E. U. Weber, & G. L. Jonathan Baron, *Conflict and tradeoffs in decision making* (pp. 86-109). Cambridge, UK: Cambridge University Press.

Lucini, D., Di Fede, G., Parati, G., & Pagani, M. (2005). Impact of chronic psychological stress on autonomic cardiovascular regulation in otherwise healthy subjects. *Hypertension, 46*, 1201-1206.

Lucini, D., Silvano, R., Pizinelli, P., & Pagani, M. (2007). Stress management at the worksite: Reversal of symptoms profile and cardiovascular dysregulation. *Hypertention, 49*, 291-297.

MacGregor, D. (1993). Time pressure and task adaptation: Alternative perspectives on laboratory studies. In O. Svenson, & A. J. Maule, *Time pressure and stress in human judgment and decision making* (pp. 73-82). New York, NY: Plenum Press.

Maclean, N. J. (2003). *Fire and ashes: On the front lines of American wildfire.* New York, NY: Henry Holt & Co.

March, J. G., & Olsen, J. P. (1986). Garbage can models of decision making in organizations. In K. G. March, R. Weissinger, & (Eds), *Ambiguity and command* (pp. 11-35). U.S.A.: Longman Inc.

Marewski, J., Pohl, F., & Vitouch, O. (2011). Recognition-based judgments and decisions: What we have learned (so far). *Judgment and Decision Making, Vol.6, No. 5*, 359-380.

Marsar, S. (2009, December 1). *Survivability profiling: Are the victims savable?* Retrieved May 21, 2010, from Fire Engineering: Unknown.

Mathews, G. (1996). Extraversion, emotion, and performance: A cognitive adaptive model. In G. Mathews (Ed.), *Congitive science perspectives on personality and emotion.* Amsterdam: Elsevier.

Maule, A., & Hockey, G. (1993). State, stress and time pressure. In O. Svensen, & A. J. Maule, *Time pressure and stress in human judgment and decision making* (pp. 83-101). New York, NY: Plenum.

Means, B., Crandall, B., Salas, E., & Jacobs, T. (1993). Training decision makers for the real world. In G. A. Klein, J. Orasanu, R. Calderwood, & C. E. Zsambok (Eds), *Decision making in action: Models and methods* (pp. 306-326). Norwood, NJ: Ablex Publishing Corporation.

Mendes, W. B., Blascovich, J., Hunter, S. B., Lickel, B., & Jost, J. T. (2007). Threatened by the unexpected: Psysiological responses during social interactions with expactancy-violating partners. *Journal of Personality and Social Psychology, 92*, 698-716.

Miller, J. G. (1960). Information input overload and psychopathology. *American Journal of Psychiatry, 116* , 695-704.

Mintz, A. (2004). Foreign policy decision making in familiar and unfamiliar settings: An experimental study of high ranking military officers. *Journal of Conflict Resolution, 48:1*, 49-62.

Mintz, A. (2005). Are leaders susceptable to negative polical advice?: An experimental study of high ranking military officers. In A. Mintz, & B. Russett (Eds), *New Directions for International Relations.* Lahman, MD: Lexington Books.

Mintz, A., Geva, N., & DeRouen, K. (1994). Mathematical models of foreign policy decision making: Compensatory vs. noncompensatory. *Synthese*, 100, 441-460.

Mintz, A., Geva, N., Redd, S. B., & Carnes, A. (1997). The effect of dynamic and static choice sets on political decision-making: An analysis using the decision board platform. *American Political Science Review 91*, 553-566.

Mongin, P. (1997). Expected utility threory. In J. Davis, W. Hands, & U. Maki (eds.), *Handbook of Economic Methodology* (pp. 342-350). London, England: Edward Elgar.

Murphy, D. (2003). Human behavior theories, models, and applications. In D. Murphy (Ed), *Looking beneath the surface of agricultural safety and health* (pp. 45-67). St. Joseph, MI: American Society of Agricultural Engineers.

National Fallen Firefighter Foundation (2005, June). National Fire Service Research Agenda Symposium. *National Fire Service Research Agenda Symposium* (pp. 1-50). Emmitsburg, MD: National Institute for Standards and Technology (NIST): Center for Fire Research.

National Fire Protection Association. (2000). *Fire investigations report summary: Keokuk, Iowa.* Quincy, MA: National Fire Protection Agency.

National Fire Protection Association. (2004). *NFPA 921: Guide for fire and explosion investigations.* Quincy, MA: NFPA.

National Fire Protection Association. (2005). *User's manual for NFPA 921: guide for fire and explosion investigations.* Sudbury, MA: Jones and Bartlett Publishers.

National Institute of Occupational Safety and Health. (April 1, 2001). *Death in the line of duty: Structure fire claims the lives of three career firefighters and three children - Iowa.* Atlanta, GA.: Centers for Disease Control and Prevention.

National Institute of Standards and Technology. (1998). *Appendix C: Decision Skills Training.* Washington D.C.: United States Government Printing Office.

National Institute of Standards and Technology. (2000, July). Fire service needs workshop proceedings: San Antonio, Texas, October 13-15, 1999. (pp. 1-50). San Antonio, TX: United States Department of Commerce.

National Wildfire Coordinating Group. (2002, January). *Wildland Fire Leadership Development Program*. Retrieved May 8, 2010, from www.fireleadership.gov

Nehemia, G., Mintz, A., & Redd, S. B. (2000). Structure and process in foreign policy decision-making . *Discussion paper, Program in Foreign Policy in Decision Making*, Texas A&M University.

Nisbett, R., & Wilson, T. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological Review 84(3)*, 231-259.

Observer, D. (2008). *Split-second decision making part of firefighters' training*. Retrieved November 8, 2008, from The Daily Observer: http://www.thedailyobserver.ca/PrintArticle.aspx?e=1243946

Omodei, M. (2006). *What psychology can tell us about how to fight fires and what firefighters can tell us about psychology.* Pittsburgh, PA: Carnegie Mellon University.

Orasanu, J., & Connelly, T. (1993). The reinvention of decision making. In G. A. Klein, J. Orasanu, R. Calderwood, & C. E. Zsambok (Eds), *Decision Making in Action: Models and Methods* (pp. 3-20). Norwood, CT: Ablex.

Ozel, F. (2001). Time pressure and stress as a factor during emegency egress. *Safety Science, 38*, 95-107.

Paulson, D. (2008, August 6). *A Workplace culture based on safety.* Retrieved May 1, 2010, from Fire Rescue: http://www.firerescue1.com/print.asp?act=print&vid=423329-a-workplace-culture-based-on-safety

Payne, J. (1976). Task complexity and contingent processing in decision making: An information search and protocol analysis. *Organizational Behavior & Human Decision Processes, 16*, 366-387.

Payne, J., & Bettman, J. (2001). Preferential choice and adaptive strategy. In G. Gigerenzer, & R. Selten (eds.), *Bounded rationality, the adaptive toolbox* (pp. 123-145). Cambridge, MA: MIT Press.

Payne, J., Bettman, J., & Johnson, E. (1988). Adaptive strategy selection in decision making. *Journal of experimental psychology: Learning, Memory, and Cognition, 14*, 534-552.

Payne, J., Bettman, J. R., & Johnson, E. J. (1993). *The Adaptive decision maker.* New York: NY: Cambridge University Press.

Payne, J., Bettman, J., & Luce, M. (1996). When time is money: Decision behavior under opportunity - cost time pressure. *Organizational Behavior & Human Decision Processes, 66*, 131-152.

Payne, J., Johnson, E., Bettman, J., & Coupey, E. (1990). Understanding contingent choice: A computer simulation approach. *IEEE Transaction on Systems, Man and Cybernetics, 10*.

Phillips, J., Klein, G., & Sieck, W. (2004). Expertise in judgment and decision making: A case for training intuitive decision skills. In D. Koehler, & N. Harvey (Eds.), *Blackwell handbook of judgment and decision making* (pp. 297-315). Malden, MA: Blackwell Publishing Ltd.

Piferi, R., Kline, K., Younger, J., & Lawler, K. (2000). An alternatvie approach for achieving cardiovascular baseline: Viewing an aquatic video. *International Journal of Psychophysiology, 37*, 207-217.

Plous, S. (1993). *The Psychology of judgment and decision making.* New York, NY: McGraw-Hill, Inc.

Putnam, T. (1995). *The Collapse of decision making and organizational structure on Storm King Mountain.* Missoula, MT: USDA Forest Service, Missoula Technology and Development Center.

Quintiere, J., & Karlson, B. (1999). *Enclosure fire dynamics.* New York, NY: CRC.

Richards, J., & Casey, B. (1991). Heart rate variability during attention phases in young infants. *Psychophysiology, 28*, 43-53.

Riedl, R., Brandstatter, E., & Roithmayr, F. (2008). Identifying decision strategies: A process and outcome-based classification method. *Behavior Research Methods*, 40(3) 795-807.

Rothstein, H. (1986). The effects of time pressure on judgment in multiple cue probability learning. *Organizational Behavior and Human Decision Processes, 37*, 83-92.

Russo, J. (1977). The value of unit price information. *Journal of Marketing Research, 14*, 193-201.

Russo, J., & Dosher, B. (1983). Strategies for multiattribute binary choice. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 9, 676-696.

Sage, A. P. (1990). Human judgment and decision rules. In A. P. Sage, *Concise encyclopedia of information processing in systems and organizations.* New York, NY: Pergamon Press.

Salas, E., Driskell, E., & Hughs, S. (1996). The study of stress and human performance. In J. Driskell, & E. Salas (Eds.), *Stress and Human Performance* (pp. 1-45). Mahwah, NJ: Lawrence Erlbaum Associates.

Savage, L. (1954). *The foundations of statistics.* New York, NY: Wiley.

Schneider, W. (1985). Training high-performance skills: Fallacies and guidelines. *Human Factors, 30*, 285-300.

Sefaty, D., MacMillan, J., Entin, E. E., & Entin, E. B. (1997). The descision-making expertise of battle commanders. In C. Zsambok, & G. Klein (Eds.), *Naturalistic decision making* (pp. 233-246). Mahwah, NJ: Lawrence Erlbaum Associates.

Seyle, H. (1976). *The stress of life (Rev. ed.).* New York, NY: McGraw-Hill.

Shanteau, J. (1988). Psychological characteristics and strategies of expert decision makers. *Acta Psychologica, 68*, 203-215.

Shepard, R. N. (1964). Circularity in judgements of relative pitch. *Journal of the Accoustical Society of America: 36*, 2346-53.

Shields, M. (1980). Some apsects of information load on search patterns used to analyze performance reports. *Accounting, Organizations, and Society*, 429-442.

Simon, H. (1978). On how to decide what to do. *Bell Journal of Economics*, 494-507.

Slovic, P., Fischhoff, B., & Lictenstein, S. (1977). Behavioral decision theory. *Annual Review of Psychology 28*, 1-38.

Svenson, O., & Edland, A. (1987). Changes of preferences under time pressure: Choices and judgments. *Scandinavian Journal of Psychology, 28*, 322-330.

Svenson, O., & Maule, A. (1993). *Time pressure and stress in human judgment and decision making.* New York, NY: Plenum.

Task Force. (1996). *Heart rate variability: Standards of measurement, physiological interpretation, and clinical use.* Dallas, TX: American Heart Association, Inc.

Todd, P., & Benbasat, I. (1987). Process tracing methods in decision support systems research. *MIS Quarterly, 11* , 492-512.

Todd, P., & Gigerenzer, G. (2001). Putting naturalistic decision making into the adaptive toolbox. *Journal of Behavioral Decision Making, Vol. 14*, 353-384.

Tomlinson, T., Marewski, J., & Dougherty, M. (2011). Four challenges for cognitive research on the recognition heuristic and a call for a research strategy shift. *Journal of Judgment and Decision Making*, 23-42.

TriData Corporation. (1998). *The wildland firefighter safety awareness study.* Arlington, VA: TriData Corporation.

Turner, B., & Pidgeon, N. (1997). *Man-made disasters (2nd ed).* Woburn, MA: Butterworth-Heinemann.

Tversky, A. (1972). Elimination by aspects: A theory of choice. *Psychological Review, 79*, 281-299.

Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology, 5*, 207-232.

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science, 185*, 1124-1131.

Useem, M., Cook, J., & Sutton, L. (2005, Vol. 4 No. 4). Developing leaders for decision making under stress: Wildland firefighters in the South Caynon fire and its aftermath. *Academy of Management Learning & Education*, pp. 461-485.

United States Fire Administration. (2008, October 3). *Computer-based firefighter trainer*. Retrieved June 3, 2010, from Department of Homeland Security: http://www.usfa.dhs.gov/fireservice/research/safety/computer.shtm

Vaughan, D. (1997, March). Targets for firefighting safety: Lessons from the Challenger tradgedy. *Wildfire*, 29-40.

Velichkovsky, B. M., & Hansen, J. P. (1996). New technological windows into the mind: There are no more eyes and brains for human computer interaction. *CHI 96 Proceedings*, (pp. 496-503). Vancouver, BC Canada.

Walter, G., & Porges, S. (1976). Heart rate and respiratory responses as a function of task difficulty: The use of discrimination analysis in the selection of psychologically sensitive physiological responses. *Psychophysiology, 13* , 563-571.

Warwick, W., McIlwaine, S., Hutton, R. J., & McDemott, P. (2001). Developing computational models of recognition-primed decision making. *Proceedings of the 10th Conference on Computer Generated Forces.* Fairborn, OH: Klein Associates, Inc.

Weber, E., Baron, J., & Loomes, G. (2001). *Conflict and tradeoff in decision making.* Cambridge, UK: Cambridge University Press.

Weick, K. E. (1993, December). The collapse of sensemaking in organizations: The Mann Gulch disaster. *Administrative Science Quarterly*, *38*(4), 628-653.

Wilkens, J. (2006, November 25). *Deadly 1956 chaos led to 'firefighting orders: Rules held sacred, but effectiveness under fire.* Retrieved May 22, 2010, from http://www.signonsandiego.com/uniontrib/20061125/news_1n25inaja.html

Winn, W., Hoffman, H., Hollander, A., Osberg, K., Rose, H., & Char, P. (1997). The effect of student construction of virtual environments on the performance of high- and low-ability students. *American Educational Research Association.* Chicago, IL.

Wolgast, K. A. (2005). *Command decision-making: Experience counts.* Carlisle Barracks, PA: United States Army War College.

Woods, D., & Roth, E. (1988). Cognitive systems engineering. In M. Helander, & M. Helander, *Handbook of Human-Computer Interaction.* Amsterdam: Elsevier Science Publishers.

Wright, P. L. (1974). The harassed decision maker: Time pressures, distractions, and the use of evidence. *Journal of Applied Psychology, 59*, 555-561.

Yates, J. (2001). Outsider impressions of naturalistic decision making. In E. Salas, & G. A. Klein, *Linking expertise and naturalistic decision making* (pp. 9-33). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Zakay, D. (1985). Post-decisional confidence and conflict experienced in a choice process. *Acta Psychologica, 58*, 75-80.

Zakay, D. (1993). The impact of time perception processes on decision making under time stress. In O. Svenson, & J. Maule (Eds), *Time Pressure and Stress in Human Judgment* (pp. 59-71). New York, NY: Plenum Press.

Zakay, D., & Wooler, S. (1984). Time pressure, training and decision effectiveness. *Ergonomics*, *27*, 273-284.

Zsambok, C. (1997). Naturalistic decision making: Where are we now? In C. Zsambok, & G. A. Klein, *Naturalistic decision making* (pp. 3-16). Mahwah, NJ: Erlbaum.

APPENDICES

Appendix A – Questionnaire

Please enter your assigned participant code for this study: ____________________

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- ☐ It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- ☐ Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

1 2 3 4 5 6 7 8 9 10 11
Low High

Physical Demand:

1 2 3 4 5 6 7 8 9 10 11
Low High

Temporal Demand:

1 2 3 4 5 6 7 8 9 10 11
Low High

Own Performance:

1 2 3 4 5 6 7 8 9 10 11
Good Bad

Effort:

1 2 3 4 5 6 7 8 9 10 11
Low High

Frustration:

1 2 3 4 5 6 7 8 9 10 11
Low High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Appendix B – Completed Questionnaires

Please enter your assigned participant code for this study: LS010

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☑ It is unlikely that people were in the house
- ☐ It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

accumulation of mail & newspapers in box & front step

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- ☐ Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☑ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Caught in kitchen - couldn't get out

Please enter your assigned participant code for this study: G5011

In this fire scenario, were there people in the house?

- [ ] Absolutely not
- [x] It is very unlikely that people were in the house
- [ ] It is unlikely that people were in the house
- [ ] It is likely that people were in the house
- [ ] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

Due to time of day, no cars in driveway, Mail hasn't been recieved for awhile.

This fire scenario was indicative of a(n):

- [ ] Incipient fire
- [x] Pre-backdraft
- [ ] Backdraft
- [ ] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

		X								
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

	X									
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

		X								
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

					X					
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

		X								
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

				X						
1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: LS012

In this fire scenario, were there people in the house?

- [ ] Absolutely not
- [ ] It is very unlikely that people were in the house
- [ ] It is unlikely that people were in the house
- [x] It is likely that people were in the house
- [ ] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

shoes near entrance

This fire scenario was indicative of a(n):

- [ ] Incipient fire
- [x] Pre-backdraft
- [ ] Backdraft
- [ ] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

						X				
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

			X							
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

						X				
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

				X						
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

						X				
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

				X						
1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

						X				
1	2	3	4	5	6	7	8	9	10	11

Low High

Physical Demand:

					X					
1	2	3	4	5	6	7	8	9	10	11

Low High

Temporal Demand:

						X				
1	2	3	4	5	6	7	8	9	10	11

Low High

Own Performance:

				X						
1	2	3	4	5	6	7	8	9	10	11

Good Bad

Effort:

							X			
1	2	3	4	5	6	7	8	9	10	11

Low High

Frustration:

							X			
1	2	3	4	5	6	7	8	9	10	11

Low High

Headphones cut out - so I was having trouble hearing information from other units

Please enter your assigned participant code for this study: LS 013

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- X It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

Shoes outside,

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- X Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

								X		
1	2	3	4	5	6	7	8	9	10	11

Low — High

Physical Demand:

			X							
1	2	3	4	5	6	7	8	9	10	11

Low — High

Temporal Demand:

							X			
1	2	3	4	5	6	7	8	9	10	11

Low — High

Own Performance:

									X	
1	2	3	4	5	6	7	8	9	10	11

Good — Bad

Effort:

									X	
1	2	3	4	5	6	7	8	9	10	11

Low — High

Frustration:

										X
1	2	3	4	5	6	7	8	9	10	11

Low — High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: HF014

In this fire scenario, were there people in the house?

- [ ] Absolutely not
- [ ] It is very unlikely that people were in the house
- [ ] It is unlikely that people were in the house
- [x] It is likely that people were in the house
- [ ] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

There was a truck in the driveway.

This fire scenario was indicative of a(n):

- [ ] Incipient fire
- [x] Pre-backdraft
- [ ] Backdraft
- [ ] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: HF015

In this fire scenario, were there people in the house?

- [ ] Absolutely not
- [ ] It is very unlikely that people were in the house
- [ ] It is unlikely that people were in the house
- [x] It is likely that people were in the house
- [ ] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

Vehicle in the driveway

This fire scenario was indicative of a(n):

- [ ] Incipient fire
- [x] Pre-backdraft
- [ ] Backdraft
- [ ] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

				X						
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

		X								
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

						X				
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

						X				
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

			X							
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

						X				
1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: #F016

In this fire scenario, were there people in the house?

- [ ] Absolutely not
- [ ] It is very unlikely that people were in the house
- [ ] It is unlikely that people were in the house
- [x] It is likely that people were in the house
- [ ] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

Truck in the Driveway

This fire scenario was indicative of a(n):

- [ ] Incipient fire
- [x] Pre-backdraft
- [ ] Backdraft
- [ ] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

							X			
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

		X								
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

							X			
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

				X						
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

						X				
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

							X			
1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

		X								
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

	X									
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

			X							
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

		X								
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

	X									
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

	X									
1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: HF017

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- ☒ It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

Additional resources delayed for vertical ventilation.
Goal is to make interior tenable for possible occupants in a timely manner.

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- ☒ Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

								X		
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

			X							
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

									X	
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

			X							
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

			X							
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

						X				
1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Too loud in headphones
overpowers

Please enter your assigned participant code for this study: HF018

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- ☐ It is likely that people were in the house
- ☑ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

After requesting for additional information, it was reported that there were people inside.

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- ☑ Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Technical Difficulties
No movement in either fire scenario
Lost headphone sound

Please rate your experience on each one of the following items:

Mental Demand: 1 2 3 4 5 6 7 8 9 10 11 (Low – High) — 8

Physical Demand: 1 2 3 4 5 6 7 8 9 10 11 (Low – High) — 5

Temporal Demand: 1 2 3 4 5 6 7 8 9 10 11 (Low – High) — 5

Own Performance: 1 2 3 4 5 6 7 8 9 10 11 (Good – Bad) — 6

Effort: 1 2 3 4 5 6 7 8 9 10 11 (Low – High) — 8

Frustration: 1 2 3 4 5 6 7 8 9 10 11 (Low – High) — 7

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: LS019

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- ☒ It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

Mail & papers build up but still must assume that people are inside until you determine that no one is by searching the home.

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- ☐ Pre-backdraft
- ☒ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand: (marked 7)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand: (marked 2)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand: (marked 6)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance: (marked 6)

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort: (marked 4)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration: (marked 7)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

	X									
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

	X									
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

	X									
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

								X		
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

	X									
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

	X									
1	2	3	4	5	6	7	8	9	10	11
Low										High

HF020

Please enter your assigned participant code for this study: HF020

In this fire scenario, were there people in the house?

- [ ] Absolutely not
- [ ] It is very unlikely that people were in the house
- [ ] It is unlikely that people were in the house
- [ ] It is likely that people were in the house
- [x] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

Car in driveway (Truck)

This fire scenario was indicative of a(n):

- [ ] Incipient fire
- [ ] Pre-backdraft
- [x] Backdraft
- [ ] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

								X		
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

				X						
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

										X
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

			X							
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

							X			
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

							X			
1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: HF021

In this fire scenario, were there people in the house?

- [ ] Absolutely not
- [ ] It is very unlikely that people were in the house
- [ ] It is unlikely that people were in the house
- [ ] It is likely that people were in the house
- [x] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

DAY TIME IN A RESIDENTIAL NEIGHBORHOOD

This fire scenario was indicative of a(n):

- [ ] Incipient fire
- [x] Pre-backdraft
- [ ] Backdraft
- [ ] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

– WAS NOT ABLE TO PULL UP DECISION MATRIX.
MADE DECISION ON WHAT I SAY.

Please enter your assigned participant code for this study: HF022

In this fire scenario, were there people in the house?

- [ ] Absolutely not
- [ ] It is very unlikely that people were in the house
- [ ] It is unlikely that people were in the house
- [x] It is likely that people were in the house
- [ ] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

CAR IN DRIVEWAY

This fire scenario was indicative of a(n):

- [ ] Incipient fire
- [x] Pre-backdraft
- [ ] Backdraft
- [ ] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Please rate your experience on each one of the following items:

Mental Demand: X at 7

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand: X at 5

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand: X at 7

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance: X at 7

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort: X at 5

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration: X at 6

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: HF023

In this fire scenario, were there people in the house?
- [ ] Absolutely not
- [ ] It is very unlikely that people were in the house
- [ ] It is unlikely that people were in the house
- [x] It is likely that people were in the house
- [ ] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

Car in the driveway - should have listened to all the information - should have walked around building -

This fire scenario was indicative of a(n):
- [ ] Incipient fire
- [ ] Pre-backdraft
- [x] Backdraft
- [ ] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Please rate your experience on each one of the following items:

Mental Demand: X at 6 (scale 1–11, Low–High)

Physical Demand: X at 1 (scale 1–11, Low–High)

Temporal Demand: X at 11 (scale 1–11, Low–High)

Own Performance: X at 5 (scale 1–11, Good–Bad)

Effort: X at 7 (scale 1–11, Low–High)

Frustration: X at 4 (scale 1–11, Low–High)

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1 2 3 4 5 6 7 8 9 10 11
Low High

Physical Demand:

1 2 3 4 5 6 7 8 9 10 11
Low High

Temporal Demand:

1 2 3 4 5 6 7 8 9 10 11
Low High

Own Performance:

1 2 3 4 5 6 7 8 9 10 11
Good Bad

Effort:

1 2 3 4 5 6 7 8 9 10 11
Low High

Frustration:

1 2 3 4 5 6 7 8 9 10 11
Low High

Please enter your assigned participant code for this study: HF024

In this fire scenario, were there people in the house?

- [ ] Absolutely not
- [ ] It is very unlikely that people were in the house
- [ ] It is unlikely that people were in the house
- [ ] It is likely that people were in the house
- [x] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

Time of Day / ~~g~~ truck in Driveway / Reported by Passer by not from Occupant

This fire scenario was indicative of a(n):

- [ ] Incipient fire
- [x] Pre-backdraft
- [ ] Backdraft
- [ ] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: HF025

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- ☒ It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

DAYTIME, CAR IN DRIVE, NO PEOPLE OUTSIDE

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- ☒ Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand: (marked 8)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand: (marked 5)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand: (marked 8)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance: (marked 7)

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort: (marked 6)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration: (marked 7)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: HF026

In this fire scenario, were there people in the house?

- [ ] Absolutely not
- [ ] It is very unlikely that people were in the house
- [ ] It is unlikely that people were in the house
- [ ] It is likely that people were in the house
- [x] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

Vehicle in Driveway

This fire scenario was indicative of a(n):

- [ ] Incipient fire
- [x] Pre-backdraft
- [ ] Backdraft
- [ ] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Please rate your experience on each one of the following items:

Mental Demand: (1 Low – 11 High) X at 8

Physical Demand: (1 Low – 11 High) X at 7

Temporal Demand: (1 Low – 11 High) X at 7

Own Performance: (1 Good – 11 Bad) X at 6

Effort: (1 Low – 11 High) X at 8

Frustration: (1 Low – 11 High) X at 8

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: HF027

In this fire scenario, were there people in the house?

- [ ] Absolutely not
- [ ] It is very unlikely that people were in the house
- [ ] It is unlikely that people were in the house
- [x] It is likely that people were in the house
- [ ] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

Truck in drive
open mailbox

Don't use HRV.

This fire scenario was indicative of a(n):

- [ ] Incipient fire
- [x] Pre-backdraft
- [ ] Backdraft
- [ ] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand: wanted to go faster

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

			X							
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

	X									
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

								X		
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

				X						
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

			X							
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

								X		
1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: HF028

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- ☒ It is likely that people were in the house — This one
- ~~☒~~ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

car in drive

day time

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- ☒ Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
					X					
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
	X									
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
								X		
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
							X			
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
			X							
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
							X			
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: HF029

In this fire scenario, were there people in the house?

- [ ] Absolutely not
- [x] It is very unlikely that people were in the house
- [ ] It is unlikely that people were in the house
- [ ] It is likely that people were in the house
- [ ] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

Daytime, Residential fire
everyone should be awake
& aware

This fire scenario was indicative of a(n):

- [ ] Incipient fire
- [ ] Pre-backdraft
- [ ] Backdraft
- [x] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

							X			
1	2	3	4	5	6	7	8	9	10	11

Low — High

Physical Demand:

					X					
1	2	3	4	5	6	7	8	9	10	11

Low — High

Temporal Demand:

						X				
1	2	3	4	5	6	7	8	9	10	11

Low — High

Own Performance:

					X					
1	2	3	4	5	6	7	8	9	10	11

Good — Bad

Effort:

						X				
1	2	3	4	5	6	7	8	9	10	11

Low — High

Frustration:

				X						
1	2	3	4	5	6	7	8	9	10	11

Low — High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: HFO 30

In this fire scenario, were there people in the house?
- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- ☑ It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

S-10 PICKUP IN DRIVEWAY.

This fire scenario was indicative of a(n):
- ☐ Incipient fire
- ☐ Pre-backdraft
- ☐ Backdraft
- ☑ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: HF031

In this fire scenario, were there people in the house?
- [ ] Absolutely not
- [ ] It is very unlikely that people were in the house
- [x] It is unlikely that people were in the house
- [ ] It is likely that people were in the house
- [ ] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

Because there was not an "I dont know Answer. I was in the middle of the day, no one came and Said someone was in the house.

This fire scenario was indicative of a(n):
- [ ] Incipient fire
- [x] Pre-backdraft
- [ ] Backdraft
- [ ] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Please rate your experience on each one of the following items:

Mental Demand: (marked 2)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand: (marked 1)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand: (marked 1 and 3)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance: (marked 2)

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort: (marked 1)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration: (marked 2)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

X										
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

X										
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

									X	
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

X										
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

X										
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

X										
1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: HF032

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- ☐ It is likely that people were in the house
- ☒ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

vehicle in driveway
I was unable to move in this scenario. I forgot that I needed to push Green button to move. I had difficulty hearing in this scenario. Head phones didn't work. they worked in the second

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- ☒ Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

							X			
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

	X									
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

				X						
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

							X			
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

				X						
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

		X								
1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

						X				
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

						X				
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

						X				
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

							X			
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

					X					
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

				X						
1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: HF033

In this fire scenario, were there people in the house?

- [ ] Absolutely not
- [ ] It is very unlikely that people were in the house
- [ ] It is unlikely that people were in the house
- [x] It is likely that people were in the house
- [ ] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

DAYTIME; COULD BE FAMILY HOME, BUT NO VISIBLE CARS IN THE DRIVEWAY

This fire scenario was indicative of a(n):

- [x] Incipient fire
- [ ] Pre-backdraft
- [ ] Backdraft
- [ ] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1 2 3 4 5 6 7 8 9 10 11
Low High

Physical Demand:

1 2 3 4 5 6 7 8 9 10 11
Low High

Temporal Demand:

1 2 3 4 5 6 7 8 9 10 11
Low High

Own Performance:

1 2 3 4 5 6 7 8 9 10 11
Good Bad

Effort:

1 2 3 4 5 6 7 8 9 10 11
Low High

Frustration:

1 2 3 4 5 6 7 8 9 10 11
Low High

Please enter your assigned participant code for this study: HF034

In this fire scenario, were there people in the house?

- [ ] Absolutely not
- [ ] It is very unlikely that people were in the house
- [ ] It is unlikely that people were in the house
- [ ] It is likely that people were in the house
- [x] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

~~the the~~ Truck in drive

This fire scenario was indicative of a(n):

- [x] Incipient fire
- [ ] Pre-backdraft
- [ ] Backdraft
- [ ] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

		X								
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

	X									
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

							X			
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

		X								
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

		X								
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

				X						
1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

#2

Please enter your assigned participant code for this study: HF035

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- ☒ It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

VEHICLE IN DRIVE

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- ☒ Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

X										
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

X										
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

X										
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

X										
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

X										
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

							X			
1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

#3

Please enter your assigned participant code for this study: 4F036

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- X It is unlikely that people were in the house
- ☐ It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

This fire scenario was indicative of a(n):

- X Incipient fire
- ☐ Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand: X at 7

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand: X at 4

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand: X at 5

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance: X at 7

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort: X at 7

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration: X at 2

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: LS 037

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☒ It is unlikely that people were in the house
- ☐ It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

Garage door was down. + news paper on the sidewalk.

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- ☒ Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: HF038

In this fire scenario, were there people in the house?

- [ ] Absolutely not
- [ ] It is very unlikely that people were in the house
- [ ] It is unlikely that people were in the house
- [x] It is likely that people were in the house
- [ ] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

~~B.~~ Vehicle in driveway / time of day

This fire scenario was indicative of a(n):

- [ ] Incipient fire
- [ ] Pre-backdraft
- [x] Backdraft
- [ ] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Please rate your experience on each one of the following items:

Mental Demand: X at 7

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand: X at 1

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand: X at 3

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance: X at 7

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort: X at 4

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration: X at 3

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

						X				
1	2	3	4	5	6	7	8	9	10	11

Low High

Physical Demand:

		X								
1	2	3	4	5	6	7	8	9	10	11

Low High

Temporal Demand:

			X							
1	2	3	4	5	6	7	8	9	10	11

Low High

Own Performance:

			X							
1	2	3	4	5	6	7	8	9	10	11

Good Bad

Effort:

			X							
1	2	3	4	5	6	7	8	9	10	11

Low High

Frustration:

		X								
1	2	3	4	5	6	7	8	9	10	11

Low High

Please enter your assigned participant code for this study: LS039

In this fire scenario, were there people in the house?

- [ ] Absolutely not
- [ ] It is very unlikely that people were in the house
- [x] It is unlikely that people were in the house
- [ ] It is likely that people were in the house
- [ ] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

Newspapers, mail, empty pool

This fire scenario was indicative of a(n):

- [ ] Incipient fire
- [ ] Pre-backdraft
- [ ] Backdraft
- [x] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Couldn't move in 2nd Scenario.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: LS0 40

In this fire scenario, were there people in the house?

☐ Absolutely not
☐ It is very unlikely that people were in the house
☐ It is unlikely that people were in the house
☒ It is likely that people were in the house
☐ It is very likely that people were in the house
☐ Absolutely

Please explain why you selected the option for the previous question.

Newspapers out front

This fire scenario was indicative of a(n):

☐ Incipient fire
☒ Pre-backdraft
☐ Backdraft
☐ Pre-flashover
☐ Flashover
☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

					X					
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

X										
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

		X								
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

					X					
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

					X					
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

							X			
1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

	X									
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

		X								
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

					X					
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

	X									
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

		X								
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

	X									
1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: LS 041

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- ☒ It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

Residential structure

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- ☒ Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: 4F042

In this fire scenario, were there people in the house?

- [ ] Absolutely not
- [ ] It is very unlikely that people were in the house
- [x] It is unlikely that people were in the house
- [ ] It is likely that people were in the house
- [ ] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

Time of Day

This fire scenario was indicative of a(n):

- [x] Incipient fire
- [ ] Pre-backdraft
- [ ] Backdraft
- [ ] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Please rate your experience on each one of the following items:

Mental Demand: ✓ 3–4

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand: ✓ 3

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand: ✓ 3

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance: ✓ 3

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort: ✓ 3

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration: ✓ 4

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: HF043

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- ☒ It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

Car in driveway / daytime

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- ☒ Pre-backdraft
- ☒ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: LS 044

In this fire scenario, were there people in the house?

- [ ] Absolutely not
- [ ] It is very unlikely that people were in the house
- [x] It is unlikely that people were in the house
- [ ] It is likely that people were in the house
- [ ] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

Middle of the day - No vehicles or signs of occupation

(Problems c̄ EKG)

This fire scenario was indicative of a(n):

- [ ] Incipient fire
- [ ] Pre-backdraft
- [ ] Backdraft
- [x] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Please rate your experience on each one of the following items:

Mental Demand: (marked at 6)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand: (marked at 5)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand: (marked at 8)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance: (marked at 5)

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort: (marked at 6)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration: (marked at 9)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: LS045

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☑ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- ☐ It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

Mail, uncollected newspaper

-> Pool Drained

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- ☑ Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand: (marked 9)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand: (marked 5)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand: (marked 8)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance: (marked 8)

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort: (marked 8)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration: (marked 2)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
										X

Low — High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
										X

Low — High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
										X

Low — High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
		X								

Good — Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
								X		

Low — High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
								X		

Low — High

Please enter your assigned participant code for this study: HF046

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- ☐ It is likely that people were in the house
- ☒ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

TRUCK IN DRIVEWAY

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- ☒ Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand: X at 4

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand: X at 1

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand: X at 4

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance: X at 6

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort: X at 2

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration: X at 6

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

IMPROVE REALISTIC SCENARIO - ADD FF

Please enter your assigned participant code for this study: 4F047

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- ☒ It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

CAR IN DRIVEWAY

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- ☒ Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
						X				
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
X										
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
						X				
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
						X				
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
						X				
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
				X						
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

					X					
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

	X									
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

						X				
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

			X							
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

				X						
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

						X				
1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: LS048

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- ☒ It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

Residential Structure
No Verification No One Home – Need to find out

This fire scenario was indicative of a(n):

- ☒ Incipient fire
- ☐ Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand: 1 2 3 4 5 6 7 **X 8** 9 10 11 (Low – High)

Physical Demand: 1 2 **X 3** 4 5 6 7 8 9 10 11 (Low – High)

Temporal Demand: 1 2 **X 3** 4 5 6 7 8 9 10 11 (Low – High)

Own Performance: 1 2 **X 3** 4 5 6 7 8 9 10 11 (Good – Bad)

Effort: 1 2 **X 3** 4 5 6 7 8 9 10 11 (Low – High)

Frustration: 1 2 3 **X 4** 5 6 7 8 9 10 11 (Low – High)

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1 2 3 4 5 6 7 8 9 10 11

Low High

Physical Demand:

1 2 3 4 5 6 7 8 9 10 11

Low High

Temporal Demand:

1 2 3 4 5 6 7 8 9 10 11

Low High

Own Performance:

1 2 3 4 5 6 7 8 9 10 11

Good Bad

Effort:

1 2 3 4 5 6 7 8 9 10 11

Low High

Frustration:

1 2 3 4 5 6 7 8 9 10 11

Low High

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Utilizing the simulator would be more efficient after a few more experiencing; i.e.- understand when the decision-making matrix should be pulled up.
Also, understanding what I am seeing - when the smoke banked down, it didn't seem like smoke; more like I had entered a basement, etc. without lights so that confused me.

Please enter your assigned participant code for this study: HF 049

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- ☐ It is likely that people were in the house
- ☒ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

Ventilation is important for the safety of the F/Fs and the residents. Smoke products kill.

This fire scenario was indicative of a(n):

- ☒ Incipient fire
- ☐ Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand: X on 6

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand: X on 3

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand: X on 8

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance: X on 5

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort: X on 7

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration: X on 9

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please enter your assigned participant code for this study: LS 050 #4

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☑ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- ☐ It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

News papers stacked up
lots-mail in mailbox
No cars on street
no young childrens toys around yard pre-school age things

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- ☑ Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand: 1 2 3 4 5 6 7 8 9 10 11 (Low – High) — marked: 10

Physical Demand: 1 2 3 4 5 6 7 8 9 10 11 (Low – High) — marked: 6

Temporal Demand: 1 2 3 4 5 6 7 8 9 10 11 (Low – High) — marked: 6

Own Performance: 1 2 3 4 5 6 7 8 9 10 11 (Good – Bad) — marked: 3

Effort: 1 2 3 4 5 6 7 8 9 10 11 (Low – High) — marked: 2

Frustration: 1 2 3 4 5 6 7 8 9 10 11 (Low – High) — marked: 2

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1 2 3 4 5 6 7 8 9 10 11

Low High

Physical Demand:

1 2 3 4 5 6 7 8 9 10 11

Low High

Temporal Demand:

1 2 3 4 5 6 7 8 9 10 11

Low High

Own Performance:

1 2 3 4 5 6 7 8 9 10 11

Good Bad

Effort:

1 2 3 4 5 6 7 8 9 10 11

Low High

Frustration:

1 2 3 4 5 6 7 8 9 10 11

Low High

Please enter your assigned participant code for this study: HF051 #2

In this fire scenario, were there people in the house?

- [ ] Absolutely not
- [ ] It is very unlikely that people were in the house
- [ ] It is unlikely that people were in the house
- [x] It is likely that people were in the house
- [ ] It is very likely that people were in the house
- [ ] Absolutely

Please explain why you selected the option for the previous question.

vehicles in driveway

This fire scenario was indicative of a(n):

- [ ] Incipient fire
- [x] Pre-backdraft
- [ ] Backdraft
- [ ] Pre-flashover
- [ ] Flashover
- [ ] Post-flashover

Please rate your experience on each one of the following items:

Mental Demand: X at 8

1 2 3 4 5 6 7 8 9 10 11
Low ... High

Physical Demand: X at 4

1 2 3 4 5 6 7 8 9 10 11
Low ... High

Temporal Demand: X at 10

1 2 3 4 5 6 7 8 9 10 11
Low ... High

Own Performance: X at 8

1 2 3 4 5 6 7 8 9 10 11
Good ... Bad

Effort: X at 6

1 2 3 4 5 6 7 8 9 10 11
Low ... High

Frustration: X at 9

1 2 3 4 5 6 7 8 9 10 11
Low ... High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

								X		
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

					X					
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

									X	
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

						X				
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

						X				
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

								X		
1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: LS052 #3

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☒ It is unlikely that people were in the house
- ☐ It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

No cars, or signs of people

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- ☒ Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: HF053 #4

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- ☒ It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

Car in Drive - Mail box LiD open

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- ☐ Pre-backdraft
- ☐ Backdraft
- ☒ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand: (marked 7)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand: (marked 2)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand: (marked 4)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance: (marked 5)

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort: (marked 4)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration: (marked 2)

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

			X							
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

			X							
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

						X				
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

						X				
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

		X								
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

							X			
1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: LS054 #2

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☑ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- ☐ It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

No cars were parked on the street, no other info was given if there were occupants

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- ☐ Pre-backdraft
- ☐ Backdraft
- ☑ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: HFOSS #3

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☐ It is unlikely that people were in the house
- ☒ It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

I assume always that the structure may be occupied unless there is reliable info from on scene resources.

This fire scenario was indicative of a(n):

- ☒ Incipient fire
- ☐ Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
								X		

Low — High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
X										

Low — High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
				X						

Low — High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
	X									

Good — Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
X										

Low — High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
								X		

Low — High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

			X							
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

X										
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

				X						
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

					X					
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

				X						
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

						X				
1	2	3	4	5	6	7	8	9	10	11
Low										High

Please enter your assigned participant code for this study: LS 056 #4

In this fire scenario, were there people in the house?

- ☐ Absolutely not
- ☐ It is very unlikely that people were in the house
- ☑ It is unlikely that people were in the house
- ☐ It is likely that people were in the house
- ☐ It is very likely that people were in the house
- ☐ Absolutely

Please explain why you selected the option for the previous question.

MAIL STILL IN MAILBOX AS IT WAS UNATTENDED

This fire scenario was indicative of a(n):

- ☐ Incipient fire
- ☑ Pre-backdraft
- ☐ Backdraft
- ☐ Pre-flashover
- ☐ Flashover
- ☐ Post-flashover

Please rate your experience on each one of the following items:

Mental Demand:

				X						
1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

X										
1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

							X			
1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

			X							
1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

					X					
1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

		~~X~~				X				
1	2	3	4	5	6	7	8	9	10	11
Low										High

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate your experience on each one of the following items:

Mental Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Physical Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Temporal Demand:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Own Performance:

1	2	3	4	5	6	7	8	9	10	11
Good										Bad

Effort:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Frustration:

1	2	3	4	5	6	7	8	9	10	11
Low										High

Appendix C – Survey

Firefighter Focus Group

*** Please enter your assigned participant code for this study.**

The staff of Iowa State University would like to thank you for your time in helping us with this research project. You are about to complete a short post-experiment survey. Your participation is voluntary and you don't have to answer any questions that make you feel uncomfortable.

The survey will remain confidential. At the project's end, researchers will destroy any personal identifying information. The data will be analyzed and presented in aggregate form to ensure confidentiality. The data will be entered into a password-protected document that only researchers will have access to. At no time will individual results be shared with anyone outside the scope of this research project.

On behalf of the fire service community and Iowa State University research staff, I appreciate your time and interest in improving the safety of the nation's fire service. Should you have any questions about the survey, please contact Shawn Bayouth at (515) 231-9091.

Thank you again for your participation in the Firefighter Post-Experiment Survey.

Sincerely,

Shawn Bayouth
PhD student - Iowa State University
Deputy Fire Chief - Ames Fire Department

*** Would you like to continue with the survey?**

- Yes
- No

What is your gender?

- Male
- Female

What is your primary race/heritage?

- Caucasian
- African-American
- Asian
- Hispanic
- Other

Firefighter Focus Group

What is your age?

- ◯ 18-25
- ◯ 26-30
- ◯ 31-35
- ◯ 36-40
- ◯ 41-45
- ◯ 46-50
- ◯ 51-55
- ◯ 56-60
- ◯ 60+

What is you education level?

- ◯ High school
- ◯ Some college
- ◯ Associate of Arts/Science
- ◯ Bachelor of Arts/Science
- ◯ Graduate degree or graduate classes

You primarily perform the duties of firefighter as a (please check one)

- ◯ Career
- ◯ Volunteer

What is your current rank?

- ◯ Fire Chief
- ◯ Deputy Chief
- ◯ Assistant Chief
- ◯ District Chief
- ◯ Captain
- ◯ Lieutenant
- ◯ Firefighter
- ◯ Other

Firefighter Focus Group

How many total years of experience do you have in the fire service?

	Years
Total Experience	

Of that experience, how many years have been as a:

	Years
Volunteer	
Career	

Do you have experience as an on-scene Incident Commander?

- Yes
- No

Please describe your incident command experience in terms of years of primary job responsibility:

	Years
Incident Command Experience	

Please STOP the survey here to begin your Virtual Reality Scenario experiments.

Please rate the level of time pressure you experienced in this scenario:

	Absolutely no time pressure	Very light time pressure	Light time pressure	Moderate time pressure	Somewhat high time pressure	High time pressure	Very high time pressure
Amount of time pressure							

In this fire scenario, were there people in the house?

- Absolutely not
- It is very unlikely that people were in the house
- It is unlikely that people were in the house
- It is likely that people were in the house
- It is very likely that people were in the house
- Absolutely

Please explain why you selected the option for the previous question.

Firefighter Focus Group

This fire scenario was indicative of a(n):

- Incipient fire
- Pre-backdraft
- Backdraft
- Pre-flashover
- Flashover
- Post-flashover

Please STOP the survey here to continue with your Virtual Reality Scenario experiments.

Please rate the level of time pressure you experienced in this scenario:

	Absolutely no time pressure	Very light time pressure	Light time pressure	Moderate time pressure	Somewhat high time pressure	High time pressure	Very high time pressure
Amount of time pressure	◯	◯	◯	◯	◯	◯	◯

The second fire scenario (inside the structure) was indicative of a(n):

- Incipient fire
- Pre-backdraft
- Backdraft
- Pre-flashover
- Flashover
- Post-flashover

Which of the following best describes your level of training in fire behavior?

- No formal training
- Approximately one training session every five years
- Approximately one training session every other year
- Annually
- Two or more trainings a year

Firefighter Focus Group

Please provide a rough estimation of the number of times you have been engaged in real life in each one of the following firefighting scenarios (do not include training props):

	Never	A few (less than 4 times)	Several (4 to 10times)	Many (10 to 30 times)	Large number (more than 30 times)
Pre-backdraft	○	○	○	○	○
Backdraft	○	○	○	○	○
Rollover	○	○	○	○	○
Pre-flashover	○	○	○	○	○
Flashover	○	○	○	○	○

Please rate the following statements as they apply to ALL of your virtual environment scenarios.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
A. While taking part in the scenarios, I felt completely engaged.	○	○	○	○	○
B. The visual aspects of the environments involved me.	○	○	○	○	○
C. While in the virtual environment, I was unaware of events occurring in the real world around me.	○	○	○	○	○
D. I was unaware of my display and control devices.	○	○	○	○	○
E. I was easily able to recognize objects.	○	○	○	○	○
F. I could examine objects from multiple viewpoints without difficulty.	○	○	○	○	○
G. I did not feel confused or disoriented at any point during the experimental sessions.	○	○	○	○	○
H. I was very involved in the virtual environment experience.	○	○	○	○	○
I. By the end of the experience, I felt proficient in moving and interacting with the virtual environments.	○	○	○	○	○
J. I was so involved in the experience that I lost track time.	○	○	○	○	○

Please rate the following statements based on ONLY the firefighting scenarios.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
A. The auditory aspects of the environment helped me feel involved.	○	○	○	○	○
B. I experienced no difficulty identifying sounds.	○	○	○	○	○
C. I was able to localize sounds.	○	○	○	○	○
D. The sound helped enhance the experience.	○	○	○	○	○
E. The radio-simulated sound helped enhance the experience.	○	○	○	○	○
F. I experienced no difficulty in understanding sounds during the experiment.	○	○	○	○	○

Firefighter Focus Group

Please rate the following statements based on ONLY the firefighting scenarios.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
A. I was visually able to survey and search the environment.	○	○	○	○	○
B. The visual display quality did not distract me from the environment.	○	○	○	○	○
C. The control mechanism did not distract me.	○	○	○	○	○
D. The control devices did not distract me from the environment.	○	○	○	○	○
E. I was able to concentrate on the environment rather than on the control mechanisms.	○	○	○	○	○

Please rate the following statements based on ONLY the firefighting scenarios.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
A. I was able to adjust easily and quickly to working in the virtual reality environment.	○	○	○	○	○
B. The interactions with the virtual environment seemed natural.	○	○	○	○	○
C. My movement through the virtual reality environment felt natural.	○	○	○	○	○
D. Controlling my movement through the virtual reality environment did not distract me from the task at hand.	○	○	○	○	○
E. My general experiences in the virtual fire environment seemed consistent with my real-world experiences.	○	○	○	○	○
F. My ability to identify fire condition indicators was consistent with my ability to identify these indications in real-life scenarios.	○	○	○	○	○

Please rate the following statements based on ONLY the firefighting scenarios.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
A. Using the decision table did not interfere with the flow of events.	○	○	○	○	○
B. The decision table provided information that I typically obtain to make real life decisions during line of action.	○	○	○	○	○

Please list any other information which was NOT available in the decision table that you might typically get over the radio.

This concludes the research survey.

Thank you again for your time and assistance in completing the Firefighter Virtual Reality experiment.

Appendix D – Experiment 1 Decision Portraits

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

5FG1_28_04-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 346.462 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Horizontally Ventilate through a window: 100%

Dimensions
Size Up Factors: 50%
Available Resources: 50%

Search Indices

Alternatives
Horizontally Ventilate through a window average: 1.000

Dimensions
Size Up Factors average: 3.000
Available Resources average: 3.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit				
Size Up Factors		2(334.332)		
Type of Structure				
Available Resources		1(319.472)		

Physiological Report

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

5FG2_28_04-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 187.494 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 63%
Horizontally Ventilate through a window: 38%

Dimensions
Risk/Benefit: 38%
Size Up Factors: 25%
Type of Structure: 13%
Available Resources: 13%
Type of Structure : 13%

Search Indices

Alternatives
Attack through main door average: 5.000
Horizontally Ventilate through a window average: 1.800

Dimensions
Risk/Benefit average: 1.800
Size Up Factors average: 1.000
Type of Structure average: 0.429
Available Resources average: 0.429
Type of Structure average: 0.429

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit	6(158.594), 7 (176.934)	8(183.734)		
Size Up Factors	2(113.404)	3(126.244)		
Type of Structure	4(138.434)			
Available Resources	1(76.884)			

Upload decision data

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Decision Process Analysis Report

Results of file:

5FG3_28_04-DecisionResultsUpdated.xml

Final Choice

Attack through main door (at: 217.612 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 29%
Horizontally Ventilate through a window: 24%
Ventilate through the roof: 24%
Ventilate from ladder truck: 24%

Dimensions
Risk/Benefit: 24%
Size Up Factors: 24%
Type of Structure: 24%
Available Resources: 29%

Search Indices

Alternatives
Attack through main door average: 1.250
Horizontally Ventilate through a window average: 0.923
Ventilate through the roof average: 0.923
Ventilate from ladder truck average: 0.923

Dimensions
Risk/Benefit average: 0.923
Size Up Factors average: 0.923
Type of Structure average: 0.923
Available Resources average: 1.250

Analysis of Completeness

User selection procedure was holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	**Horizontally Ventilate through a window**	**Ventilate through the roof**	**Ventilate from ladder truck**
Risk/Benefit	1(50.732)	2(60.492)	3(72.532)	4(80.092)
Size Up Factors	5(86.402)	6(97.462)	7(106.012)	8(114.722)
Type of Structure	9(123.032)	10(135.812)	11(145.492)	12(153.062)
Available Resources	13(165.822), 18(208.052)	14(173.952)	15(182.652)	16(190.142)

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

5FG4_28_04-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 304.404 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 100%

Dimensions
Type of Structure: 100%

Search Indices

Alternatives
Attack through main door average: 1.000

Dimensions
Type of Structure average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit				
Size Up Factors				
Type of Structure	1(113.144)			
Available Resources				

Physiological Report

Blood Pressure

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

5FG5_28_04-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 363.914 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 25%
Horizontally Ventilate through a window: 25%
Ventilate through the roof: 25%
Ventilate from ladder truck: 25%

Dimensions
Risk/Benefit: 25%
Size Up Factors: 25%
Type of Structure: 25%
Available Resources: 25%

Search Indices

Alternatives
Attack through main door average: 1.000
Horizontally Ventilate through a window average: 1.000
Ventilate through the roof average: 1.000
Ventilate from ladder truck average: 1.000

Dimensions
Risk/Benefit average: 1.000
Size Up Factors average: 1.000
Type of Structure average: 1.000
Available Resources average: 1.000

Analysis of Completeness

User selection procedure was holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	**Horizontally Ventilate through a window**	**Ventilate through the roof**	**Ventilate from ladder truck**
Risk/Benefit	1(204.794)	5(245.944)	9(287.704)	13(313.284)
Size Up Factors	2(216.194)	6(258.404)	10(295.534)	14(324.444)
Type of Structure	3(227.354)	7(265.834)	11(302.724)	15(333.284)
Available Resources	4(237.414)	8(275.914)	12(306.814)	16(346.084)

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

3FG6_19_05-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 81.598 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 33%
Horizontally Ventilate through a window: 33%
Ventilate through the roof: 33%

Dimensions
Risk/Benefit: 50%
Size Up Factors: 50%

Search Indices

Alternatives
Attack through main door average: 1.500
Horizontally Ventilate through a window average: 1.500
Ventilate through the roof average: 1.500

Dimensions
Risk/Benefit average: 3.000
Size Up Factors average: 3.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit	4(53.478)	5(62.098)	6(71.738)	
Size Up Factors	1(24.578)	2(36.408)	3(44.678)	
Type of Structure				
Available Resources				

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

6FG001_28_05-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 257.000 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 43%
Horizontally Ventilate through a window: 29%
Ventilate through the roof: 14%
Ventilate from ladder truck: 14%

Dimensions
Risk/Benefit: 29%
Size Up Factors: 29%
Available Resources: 43%

Search Indices

Alternatives
Attack through main door average: 2.250
Horizontally Ventilate through a window average: 1.200
Ventilate through the roof average: 0.500
Ventilate from ladder truck average: 0.500

Dimensions
Risk/Benefit average: 1.200
Size Up Factors average: 1.200
Available Resources average: 2.250

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	**Horizontally Ventilate through a window**	**Ventilate through the roof**	**Ventilate from ladder truck**
Risk/Benefit	1(100.640)		2(119.450)	
Size Up Factors	3(144.690)	6(221.900)		
Type of Structure				
Available Resources	4(163.450)	5(195.320)		7(239.730)

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

6FG002_28_05-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 149.916 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 80%
Horizontally Ventilate through a window: 20%

Dimensions
Risk/Benefit: 20%
Size Up Factors: 20%
Type of Structure: 20%
Available Resources: 40%

Search Indices

Alternatives
Attack through main door average: 12.000
Horizontally Ventilate through a window average: 0.750

Dimensions
Risk/Benefit average: 0.750
Size Up Factors average: 0.750
Type of Structure average: 0.750
Available Resources average: 2.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	**Horizontally Ventilate through a window**	**Ventilate through the roof**	**Ventilate from ladder truck**
Risk/Benefit	1(44.056)			
Size Up Factors	2(70.126)			
Type of Structure	3(82.676)			
Available Resources	4(98.966)	5(126.186)		

Upload decision data

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Decision Process Analysis Report

Results of file:

6FG003_28_05-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 102.162 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 60%
Horizontally Ventilate through a window: 20%
Ventilate through the roof: 20%

Dimensions
Size Up Factors: 40%
Type of Structure: 20%
Available Resources: 40%

Search Indices

Alternatives
Attack through main door average: 4.500
Horizontally Ventilate through a window average: 0.750
Ventilate through the roof average: 0.750

Dimensions
Size Up Factors average: 2.000
Type of Structure average: 0.750
Available Resources average: 2.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit				
Size Up Factors	1(28.262)		2(46.772)	
Type of Structure	3(57.342)			
Available Resources	5(84.862)	4(75.472)		

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6FG004_28_05-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 182.686 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 75%
Horizontally Ventilate through a window: 25%

Dimensions
Risk/Benefit: 25%
Size Up Factors: 50%
Available Resources: 25%

Search Indices

Alternatives
Attack through main door average: 9.000
Horizontally Ventilate through a window average: 1.000

Dimensions
Risk/Benefit average: 1.000
Size Up Factors average: 3.000
Available Resources average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit	4(168.796)			
Size Up Factors	3(157.516)	2(143.986)		
Type of Structure				
Available Resources	1(129.096)			

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6FG005_28_05-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 175.878 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 14%
Horizontally Ventilate through a window: 43%
Ventilate through the roof: 29%
Ventilate from ladder truck: 14%

Dimensions
Risk/Benefit: 57%
Size Up Factors: 14%
Available Resources: 29%

Search Indices

Alternatives
Attack through main door average: 0.500
Horizontally Ventilate through a window average: 2.250
Ventilate through the roof average: 1.200
Ventilate from ladder truck average: 0.500

Dimensions
Risk/Benefit average: 4.000
Size Up Factors average: 0.500
Available Resources average: 1.200

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	**Horizontally Ventilate through a window**	**Ventilate through the roof**	**Ventilate from ladder truck**
Risk/Benefit	2(130.168)	3(138.718)	4(141.638)	5(149.208)
Size Up Factors		6(157.208)		
Type of Structure				
Available Resources		7(162.508)	1(26.538)	

Upload decision data

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Decision Process Analysis Report

Results of file:

6FG006-DecisionResultsUpdated.xml

Final Choice

Attack through main door (at: 117.747 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 29%
Horizontally Ventilate through a window: 43%
Ventilate through the roof: 14%
Ventilate from ladder truck: 14%

Dimensions
Size Up Factors: 57%
Available Resources: 43%

Search Indices

Alternatives
Attack through main door average: 1.200
Horizontally Ventilate through a window average: 2.250
Ventilate through the roof average: 0.500
Ventilate from ladder truck average: 0.500

Dimensions
Size Up Factors average: 4.000
Available Resources average: 2.250

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit				
Size Up Factors	1(31.107)	2(42.687)	3(51.247)	4(67.617)
Type of Structure				
Available Resources	5(85.997)	6(95.007), 7(97.097)		

Upload decision data

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Decision Process Analysis Report

Results of file:

6FG007-DecisionResultsUpdated.xml

Final Choice

Ventilate through the roof (at: 154.441 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 50%
Ventilate through the roof: 25%
Ventilate from ladder truck: 25%

Dimensions
Risk/Benefit: 75%
Type of Structure: 25%

Search Indices

Alternatives
Attack through main door average: 3.000
Ventilate through the roof average: 1.000
Ventilate from ladder truck average: 1.000

Dimensions
Risk/Benefit average: 9.000
Type of Structure average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit	1(83.081)		3(126.611)	2(118.261)
Size Up Factors				
Type of Structure	4(140.011)			
Available Resources				

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

6FG008-DecisionResultsUpdated.xml

Final Choice

Ventilate through the roof (at: 58.939 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 50%
Horizontally Ventilate through a window: 25%
Ventilate through the roof: 25%

Dimensions
Risk/Benefit: 75%
Type of Structure: 25%

Search Indices

Alternatives
Attack through main door average: 3.000
Horizontally Ventilate through a window average: 1.000
Ventilate through the roof average: 1.000

Dimensions
Risk/Benefit average: 9.000
Type of Structure average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit	1(13.709)	3(33.759)	2(25.049)	
Size Up Factors				
Type of Structure	4(43.119)			
Available Resources				

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

6FG009-DecisionResultsUpdated.xml

Final Choice

Attack through main door (at: 254.809 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 36%
Horizontally Ventilate through a window: 27%
Ventilate through the roof: 18%
Ventilate from ladder truck: 18%

Dimensions
Risk/Benefit: 36%
Size Up Factors: 18%
Type of Structure: 9%
Available Resources: 36%

Search Indices

Alternatives
Attack through main door average: 1.714
Horizontally Ventilate through a window average: 1.125
Ventilate through the roof average: 0.667
Ventilate from ladder truck average: 0.667

Dimensions
Risk/Benefit average: 1.714
Size Up Factors average: 0.667
Type of Structure average: 0.300
Available Resources average: 1.714

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	**Horizontally Ventilate through a window**	**Ventilate through the roof**	**Ventilate from ladder truck**
Risk/Benefit	3(161.129)	4(170.729)	5(179.799)	6(187.219)
Size Up Factors	1(134.909)	2(146.779)		
Type of Structure	7(194.919)			
Available Resources	8(207.869)	10(232.369)	9(219.159)	11(243.399)

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6LS010-DecisionResultsUpdated.xml

Final Choice

Ventilate through the roof (at: 223.618 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 44%
Horizontally Ventilate through a window: 11%
Ventilate through the roof: 33%
Ventilate from ladder truck: 11%

Dimensions
Size Up Factors: 44%
Type of Structure: 22%
Available Resources: 11%
Risk/Benefit: 22%

Search Indices

Alternatives
Attack through main door average: 2.400
Horizontally Ventilate through a window average: 0.375
Ventilate through the roof average: 1.500
Ventilate from ladder truck average: 0.375

Dimensions
Size Up Factors average: 2.400
Type of Structure average: 0.857
Available Resources average: 0.375
Risk/Benefit average: 0.857

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	**Horizontally Ventilate through a window**	**Ventilate through the roof**	**Ventilate from ladder truck**
Risk/Benefit			4(162.438)	6(179.138)
Size Up Factors	1(129.988), 8 (197.778)	2(145.978)	3(153.778)	
Type of Structure	9(209.688)		5(169.918)	
Available Resources	7(186.878)			

Upload decision data

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Decision Process Analysis Report

Results of file:

6LS011-DecisionResultsUpdated.xml

Final Choice

Attack through main door (at: 212.154 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 67%
Horizontally Ventilate through a window: 17%
Ventilate through the roof: 17%

Dimensions
Size Up Factors: 33%
Type of Structure: 33%
Available Resources: 33%

Search Indices

Alternatives
Attack through main door average: 6.000
Horizontally Ventilate through a window average: 0.600
Ventilate through the roof average: 0.600

Dimensions
Size Up Factors average: 1.500
Type of Structure average: 1.500
Available Resources average: 1.500

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	**Horizontally Ventilate through a window**	**Ventilate through the roof**	**Ventilate from ladder truck**
Risk/Benefit				
Size Up Factors	1(91.454), 6 (185.374)			
Type of Structure	2(120.794)	3(140.004)		
Available Resources	4(149.764)		5(161.744)	

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6LS012-DecisionResultsUpdated.xml

Final Choice

Ventilate through the roof (at: 286.768 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 44%
Horizontally Ventilate through a window: 22%
Ventilate through the roof: 22%
Ventilate from ladder truck: 11%

Dimensions
Risk/Benefit: 44%
Size Up Factors: 33%
Type of Structure: 11%
Available Resources: 11%

Search Indices

Alternatives
Attack through main door average: 2.400
Horizontally Ventilate through a window average: 0.857
Ventilate through the roof average: 0.857
Ventilate from ladder truck average: 0.375

Dimensions
Risk/Benefit average: 2.400
Size Up Factors average: 1.500
Type of Structure average: 0.375
Available Resources average: 0.375

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	**Horizontally Ventilate through a window**	**Ventilate through the roof**	**Ventilate from ladder truck**
Risk/Benefit	2(198.838)	5(232.138)	6(242.748)	7(250.338)
Size Up Factors	1(186.618)	8(260.578)	9(268.028)	
Type of Structure	3(208.188)			
Available Resources	4(222.298)			

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6LS013-DecisionResultsUpdated.xml

Final Choice

Attack through main door (at: 307.179 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 31%
Horizontally Ventilate through a window: 23%
Ventilate through the roof: 38%
Ventilate from ladder truck: 8%

Dimensions
Size Up Factors: 15%
Type of Structure: 15%
Available Resources: 46%
Risk/Benefit: 23%

Search Indices

Alternatives
Attack through main door average: 1.333
Horizontally Ventilate through a window average: 0.900
Ventilate through the roof average: 1.875
Ventilate from ladder truck average: 0.250

Dimensions
Size Up Factors average: 0.545
Type of Structure average: 0.545
Available Resources average: 2.571
Risk/Benefit average: 0.900

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit		3(162.559)	5(180.979)	4(174.409)
Size Up Factors	1(129.759)		6(189.489)	
Type of Structure	2(143.109)		7(203.289)	
Available Resources	9(236.179), 14 (298.329)	10(246.339), 12 (280.269)	8(213.309), 13 (292.939)	

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF014-DecisionResultsUpdated.xml

Final Choice

Ventilate through the roof (at: 213.647 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 38%
Horizontally Ventilate through a window: 38%
Ventilate through the roof: 25%

Dimensions
Risk/Benefit: 38%
Size Up Factors: 38%
Available Resources: 13%
Type of Structure: 13%

Search Indices

Alternatives
Attack through main door average: 1.800
Horizontally Ventilate through a window average: 1.800
Ventilate through the roof average: 1.000

Dimensions
Risk/Benefit average: 1.800
Size Up Factors average: 1.800
Available Resources average: 0.429
Type of Structure average: 0.429

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	**Horizontally Ventilate through a window**	**Ventilate through the roof**	**Ventilate from ladder truck**
Risk/Benefit	1(138.007)	4(173.317)	7(191.887)	
Size Up Factors	2(150.587)	5(182.557)	8(199.577)	
Type of Structure		6(187.487)		
Available Resources	3(160.477)			

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF015-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 184.117 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 33%
Horizontally Ventilate through a window: 67%

Dimensions
Risk/Benefit: 33%
Type of Structure: 33%
Available Resources: 33%

Search Indices

Alternatives
Attack through main door average: 1.500
Horizontally Ventilate through a window average: 6.000

Dimensions
Risk/Benefit average: 1.500
Type of Structure average: 1.500
Available Resources average: 1.500

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit	3(172.417)			
Size Up Factors				
Type of Structure		1(138.857)		
Available Resources		2(152.777)		

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF016-DecisionResultsUpdated.xml

Final Choice

Ventilate through the roof (at: 323.682 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 40%
Horizontally Ventilate through a window: 20%
Ventilate through the roof: 40%

Dimensions
Risk/Benefit: 30%
Size Up Factors: 20%
Type of Structure: 20%
Available Resources: 30%

Search Indices

Alternatives
Attack through main door average: 2.000
Horizontally Ventilate through a window average: 0.750
Ventilate through the roof average: 2.000

Dimensions
Risk/Benefit average: 1.286
Size Up Factors average: 0.750
Type of Structure average: 0.750
Available Resources average: 1.286

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit	1(150.302)	9(282.082)	7(242.122)	
Size Up Factors	2(167.822)		5(217.682)	
Type of Structure	3(180.872)		6(231.382)	
Available Resources	4(193.942)	10(292.882)	8(257.532)	

Upload decision data

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Decision Process Analysis Report

Results of file:

6HF017-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 321.685 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 29%
Horizontally Ventilate through a window: 21%
Ventilate through the roof: 14%
Ventilate from ladder truck: 36%

Dimensions
Risk/Benefit: 43%
Available Resources: 36%
Type of Structure: 21%

Search Indices

Alternatives
Attack through main door average: 1.200
Horizontally Ventilate through a window average: 0.818
Ventilate through the roof average: 0.500
Ventilate from ladder truck average: 1.667

Dimensions
Risk/Benefit average: 2.250
Available Resources average: 1.667
Type of Structure average: 0.818

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	**Horizontally Ventilate through a window**	**Ventilate through the roof**	**Ventilate from ladder truck**
Risk/Benefit	2(171.085), 3 (175.725)	1(156.135)	4(184.795)	5(192.405), 6 (201.955)
Size Up Factors				
Type of Structure		14(307.325)		7(219.105), 8 (224.625)

Upload decision data

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Decision Process Analysis Report

Results of file:

6HF018-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 158.914 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 80%
Horizontally Ventilate through a window: 20%

Dimensions
Risk/Benefit: 40%
Size Up Factors: 20%
Type of Structure: 20%
Available Resources: 20%

Search Indices

Alternatives
Attack through main door average: 12.000
Horizontally Ventilate through a window average: 0.750

Dimensions
Risk/Benefit average: 2.000
Size Up Factors average: 0.750
Type of Structure average: 0.750
Available Resources average: 0.750

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	**Horizontally Ventilate through a window**	**Ventilate through the roof**	**Ventilate from ladder truck**
Risk/Benefit	1(96.164)	5(144.714)		
Size Up Factors	2(105.184)			
Type of Structure	3(119.714)			
Available Resources	4(128.164)			

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6LS019-DecisionResultsUpdated.xml

Final Choice

Ventilate through the roof (at: 237.430 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 67%
Horizontally Ventilate through a window: 17%
Ventilate through the roof: 17%

Dimensions
Risk/Benefit: 50%
Size Up Factors: 17%
Type of Structure: 17%
Available Resources: 17%

Search Indices

Alternatives
Attack through main door average: 6.000
Horizontally Ventilate through a window average: 0.600
Ventilate through the roof average: 0.600

Dimensions
Risk/Benefit average: 3.000
Size Up Factors average: 0.600
Type of Structure average: 0.600
Available Resources average: 0.600

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	**Horizontally Ventilate through a window**	**Ventilate through the roof**	**Ventilate from ladder truck**
Risk/Benefit	4(186.910)	5(217.870)	6(227.020)	
Size Up Factors	2(146.690)			
Type of Structure	1(128.630)			
Available Resources	3(164.790)			

Physiological Report

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF020-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 268.891 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 29%
Horizontally Ventilate through a window: 50%
Ventilate through the roof: 21%

Dimensions
Risk/Benefit: 36%
Size Up Factors: 21%
Type of Structure: 14%
Available Resources: 29%

Search Indices

Alternatives
Attack through main door average: 1.200
Horizontally Ventilate through a window average: 3.000
Ventilate through the roof average: 0.818

Dimensions
Risk/Benefit average: 1.667
Size Up Factors average: 0.818
Type of Structure average: 0.500
Available Resources average: 1.200

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	**Horizontally Ventilate through a window**	**Ventilate through the roof**	**Ventilate from ladder truck**
Risk/Benefit	5(182.231)	1(136.991), 6 (193.011), 10 (226.701)	11(229.311)	
Size Up Factors	7(197.271)	2(148.621)	12(237.171)	
Type of Structure	9(218.351)	3(156.621)		
Available Resources	8(209.671)	4(168.851), 14 (259.131)	13(252.251)	

Upload decision data

File: Browse... Upload

Decision Process Analysis Repo

Results of file:

6HF021-DecisionResultsUpdated.xml

Final Choice

Attack through main door (at: 161.439 seconds)
Smoke level (inches from the floor): __

Selection Percentages

No Selections were made

Search Indices

No Selections were made

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit				
Size Up Factors				
Type of Structure				
Available Resources				

Physiological Report

Blood Pressure

No data available

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF022-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 140.518 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 67%
Horizontally Ventilate through a window: 17%
Ventilate from ladder truck: 17%

Dimensions
Risk/Benefit: 17%
Size Up Factors: 17%
Type of Structure: 17%
Available Resources: 50%

Search Indices

Alternatives
Attack through main door average: 6.000
Horizontally Ventilate through a window average: 0.600
Ventilate from ladder truck average: 0.600

Dimensions
Risk/Benefit average: 0.600
Size Up Factors average: 0.600
Type of Structure average: 0.600
Available Resources average: 3.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit	3(83.358)			
Size Up Factors	1(53.078)			
Type of Structure	2(68.928)			
Available Resources	4(93.478)	6(128.708)		5(107.748)

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF023-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 75.906 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 80%
Horizontally Ventilate through a window: 20%

Dimensions
Risk/Benefit: 20%
Size Up Factors: 20%
Type of Structure: 20%
Available Resources: 40%

Search Indices

Alternatives
Attack through main door average: 12.000
Horizontally Ventilate through a window average: 0.750

Dimensions
Risk/Benefit average: 0.750
Size Up Factors average: 0.750
Type of Structure average: 0.750
Available Resources average: 2.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit	1(20.436)			
Size Up Factors	2(30.436)			
Type of Structure	3(37.216)			
Available Resources	4(49.626)	5(58.926)		

Upload decision data

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Decision Process Analysis Report

Results of file:

6HF024-DecisionResultsUpdated.xml

Final Choice

Ventilate through the roof (at: 126.810 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 20%
Horizontally Ventilate through a window: 20%
Ventilate through the roof: 20%
Ventilate from ladder truck: 40%

Dimensions
Risk/Benefit: 80%
Size Up Factors: 20%

Search Indices

Alternatives
Attack through main door average: 0.750
Horizontally Ventilate through a window average: 0.750
Ventilate through the roof average: 0.750
Ventilate from ladder truck average: 2.000

Dimensions
Risk/Benefit average: 12.000
Size Up Factors average: 0.750

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit	1(24.700)	4(89.070)	2(49.120)	3(71.440)
Size Up Factors				5(106.820)
Type of Structure				
Available Resources				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF025-DecisionResultsUpdated.xml

Final Choice

Attack through main door (at: 171.412 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 75%
Horizontally Ventilate through a window: 25%

Dimensions
Risk/Benefit: 25%
Size Up Factors: 50%
Type of Structure: 25%

Search Indices

Alternatives
Attack through main door average: 9.000
Horizontally Ventilate through a window average: 1.000

Dimensions
Risk/Benefit average: 1.000
Size Up Factors average: 3.000
Type of Structure average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit	1(99.712)			
Size Up Factors	2(114.732)	3(131.442)		
Type of Structure	4(139.032)			
Available Resources				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF026-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 207.109 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 40%
Horizontally Ventilate through a window: 30%
Ventilate through the roof: 20%
Ventilate from ladder truck: 10%

Dimensions
Risk/Benefit: 40%
Size Up Factors: 30%
Type of Structure: 10%
Available Resources: 20%

Search Indices

Alternatives
Attack through main door average: 2.000
Horizontally Ventilate through a window average: 1.286
Ventilate through the roof average: 0.750
Ventilate from ladder truck average: 0.333

Dimensions
Risk/Benefit average: 2.000
Size Up Factors average: 1.286
Type of Structure average: 0.333
Available Resources average: 0.750

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit	1(27.569)	5(84.889)	6(109.309)	8(132.889)
Size Up Factors	2(41.829)	9(174.859)	7(117.019)	
Type of Structure	4(65.829)			
Available Resources	3(53.579)	10(184.619)		

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF027-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 173.886 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 40%
Horizontally Ventilate through a window: 30%
Ventilate through the roof: 20%
Ventilate from ladder truck: 10%

Dimensions
Risk/Benefit: 30%
Size Up Factors: 30%
Available Resources: 40%

Search Indices

Alternatives
Attack through main door average: 2.000
Horizontally Ventilate through a window average: 1.286
Ventilate through the roof average: 0.750
Ventilate from ladder truck average: 0.333

Dimensions
Risk/Benefit average: 1.286
Size Up Factors average: 1.286
Available Resources average: 2.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	**Horizontally Ventilate through a window**	**Ventilate through the roof**	**Ventilate from ladder truck**
Risk/Benefit	3(69.586), 10 (157.026)	7(124.766)		
Size Up Factors	2(41.456)	8(134.006)	4(87.156)	
Type of Structure				
Available Resources	1(20.016)	6(107.196)	5(98.086)	9(142.966)

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF028-DecisionResultsUpdated.xml

Final Choice

Attack through main door (at: 246.497 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 20%
Horizontally Ventilate through a window: 20%
Ventilate through the roof: 60%

Dimensions
Risk/Benefit: 50%
Available Resources: 30%
Size Up Factors: 10%
Type of Structure: 10%

Search Indices

Alternatives
Attack through main door average: 0.750
Horizontally Ventilate through a window average: 0.750
Ventilate through the roof average: 4.500

Dimensions
Risk/Benefit average: 3.000
Available Resources average: 1.286
Size Up Factors average: 0.333
Type of Structure average: 0.333

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	**Horizontally Ventilate through a window**	**Ventilate through the roof**	**Ventilate from ladder truck**
Risk/Benefit	1(130.707)	3(171.707)	2(141.017), 4 (185.227), 5 (187.877)	
Size Up Factors			6(194.047)	
Type of Structure			7(201.417)	
Available Resources	10(234.537)	9(223.987)	8(206.467)	

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF029-DecisionResultsUpdated.xml

Final Choice

Ventilate through the roof (at: 170.518 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Ventilate through the roof: 80%
Ventilate from ladder truck: 20%

Dimensions
Size Up Factors: 20%
Type of Structure: 20%
Available Resources: 40%
Risk/Benefit: 20%

Search Indices

Alternatives
Ventilate through the roof average: 12.000
Ventilate from ladder truck average: 0.750

Dimensions
Size Up Factors average: 0.750
Type of Structure average: 0.750
Available Resources average: 2.000
Risk/Benefit average: 0.750

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Horizontally Ventilate through a window	**Ventilate through the roof**	**Ventilate from ladder truck**	**Attack through main door**
Size Up Factors		1(101.768)		
Type of Structure		2(117.738)		
Available Resources		3(126.408)	4(145.518)	
Risk/Benefit		5(161.598)		

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF030-DecisionResultsUpdated.xml

Final Choice

Attack through main door (at: 195.795 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Ventilate through the roof: 50%
Attack through main door: 50%

Dimensions
Type of Structure: 75%
Available Resources: 25%

Search Indices

Alternatives
Ventilate through the roof average: 3.000
Attack through main door average: 3.000

Dimensions
Type of Structure average: 9.000
Available Resources average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Ventilate through the roof	Ventilate from ladder truck	Attack through main door	Horizontally Ventilate through a window
Type of Structure	2(149.075)		1(127.725), 4 (187.895)	
Available Resources	3(157.415)			
Risk/Benefit				
Size Up Factors				

Upload decision data

File: Browse... Upload

Decision Process Analysis Repo

Results of file:

6HF031-DecisionResultsUpdated.xml

Final Choice

Attack through main door (at: 64.668 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Ventilate from ladder truck: 100%

Dimensions
Type of Structure: 100%

Search Indices

Alternatives
Ventilate from ladder truck average: 1.000

Dimensions
Type of Structure average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Ventilate from ladder truck	**Attack through main door**	**Horizontally Ventilate through a window**	**Ventilate through the roof**
Available Resources				
Risk/Benefit				
Size Up Factors				
Type of Structure	1(44.268)			

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF032-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 97.747 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Horizontally Ventilate through a window: 100%

Dimensions
Size Up Factors: 25%
Type of Structure: 25%
Available Resources: 25%
Risk/Benefit: 25%

Search Indices

Alternatives
Horizontally Ventilate through a window average: 1.000

Dimensions
Size Up Factors average: 1.000
Type of Structure average: 1.000
Available Resources average: 1.000
Risk/Benefit average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck	Attack through main door
Size Up Factors	1(35.827)			
Type of Structure	2(44.767)			
Available Resources	3(61.047)			
Risk/Benefit	4(72.307)			

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF033-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 155.637 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Ventilate through the roof: 44%
Ventilate from ladder truck: 11%
Attack through main door: 22%
Horizontally Ventilate through a window: 22%

Dimensions
Type of Structure: 33%
Available Resources: 44%
Risk/Benefit: 11%
Size Up Factors: 11%

Search Indices

Alternatives
Ventilate through the roof average: 2.400
Ventilate from ladder truck average: 0.375
Attack through main door average: 0.857
Horizontally Ventilate through a window average: 0.857

Dimensions
Type of Structure average: 1.500
Available Resources average: 2.400
Risk/Benefit average: 0.375
Size Up Factors average: 0.375

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Ventilate through the roof	Ventilate from ladder truck	Attack through main door	Horizontally Ventilate through a window
Type of Structure	1(19.077)		5(58.827)	8(145.557)
Available Resources	2(24.657)	7(128.067)	6(110.637)	9(146.567)
Risk/Benefit	3(40.317)			
Size Up Factors	4(50.307)			

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF034-DecisionResultsUpdated.xml

Final Choice

Attack through main door (at: 105.398 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Ventilate from ladder truck: 50%
Attack through main door: 50%

Dimensions
Available Resources: 50%
Size Up Factors: 50%

Search Indices

Alternatives
Ventilate from ladder truck average: 3.000
Attack through main door average: 3.000

Dimensions
Available Resources average: 3.000
Size Up Factors average: 3.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Ventilate from ladder truck	**Attack through main door**	**Horizontally Ventilate through a window**	**Ventilate through the roof**
Available Resources	1(61.478)			
Risk/Benefit				
Size Up Factors		2(97.288)		
Type of Structure				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF035-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 206.318 seconds)
Smoke level (inches from the floor): __

Selection Percentages

No Selections were made

Search Indices

No Selections were made

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck	Attack through main door
Size Up Factors				
Type of Structure				
Available Resources				
Risk/Benefit				

Physiological Report

Blood Pressure

No data available

Heart Rate

No data available

Heart Rate Variability: HF/LF

No data available

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF036-DecisionResultsUpdated.xml

Final Choice

Ventilate from ladder truck (at: 175.053 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Ventilate through the roof: 20%
Ventilate from ladder truck: 40%
Attack through main door: 40%

Dimensions
Type of Structure: 100%

Search Indices

Alternatives
Ventilate through the roof average: 0.750
Ventilate from ladder truck average: 2.000
Attack through main door average: 2.000

Dimensions
Type of Structure average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Ventilate through the roof	**Ventilate from ladder truck**	**Attack through main door**	**Horizontally Ventilate through a window**
Type of Structure	2(130.613)	4(153.053), 5 (157.763)	1(122.703), 3 (141.753)	
Available Resources				
Risk/Benefit				
Size Up Factors				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6LS037-DecisionResultsUpdated.xml

Final Choice

Ventilate from ladder truck (at: 179.477 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Horizontally Ventilate through a window: 40%
Ventilate through the roof: 40%
Ventilate from ladder truck: 20%

Dimensions
Risk/Benefit: 40%
Size Up Factors: 20%
Type of Structure: 40%

Search Indices

Alternatives
Horizontally Ventilate through a window average: 2.000
Ventilate through the roof average: 2.000
Ventilate from ladder truck average: 0.750

Dimensions
Risk/Benefit average: 2.000
Size Up Factors average: 0.750
Type of Structure average: 2.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	**Horizontally Ventilate through a window**	**Ventilate through the roof**	**Ventilate from ladder truck**
Risk/Benefit		1(129.087)	3(150.327)	
Size Up Factors		2(141.267)		
Type of Structure			4(157.657)	5(166.017)
Available Resources				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF038-DecisionResultsUpdated.xml

Final Choice

Ventilate through the roof (at: 118.132 seconds)
Smoke level (inches from the floor): __

Selection Percentages

No Selections were made

Search Indices

No Selections were made

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck	Attack through main door
Size Up Factors				
Type of Structure				
Available Resources				
Risk/Benefit				

Physiological Report

Blood Pressure

No data available

Heart Rate

No data available

Heart Rate Variability: HF/LF

No data available

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6LS039-DecisionResultsUpdated.xml

Final Choice

Ventilate through the roof (at: 458.206 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 38%
Horizontally Ventilate through a window: 31%
Ventilate from ladder truck: 31%

Dimensions
Risk/Benefit: 23%
Size Up Factors: 23%
Type of Structure: 23%
Available Resources: 31%

Search Indices

Alternatives
Attack through main door average: 1.875
Horizontally Ventilate through a window average: 1.333
Ventilate from ladder truck average: 1.333

Dimensions
Risk/Benefit average: 0.900
Size Up Factors average: 0.900
Type of Structure average: 0.900
Available Resources average: 1.333

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit	1(259.456)	6(333.866)		10(379.816)
Size Up Factors	2(280.556)	7(344.186)		11(388.216)
Type of Structure	3(292.296)	8(352.706)		12(396.686)
Available Resources	4(308.546), 5 (321.166)	9(360.046)		13(405.256)

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6LS040-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 431.865 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 42%
Horizontally Ventilate through a window: 25%
Ventilate through the roof: 17%
Ventilate from ladder truck: 17%

Dimensions
Risk/Benefit: 25%
Size Up Factors: 29%
Type of Structure: 29%
Available Resources: 17%

Search Indices

Alternatives
Attack through main door average: 2.143
Horizontally Ventilate through a window average: 1.000
Ventilate through the roof average: 0.600
Ventilate from ladder truck average: 0.600

Dimensions
Risk/Benefit average: 1.000
Size Up Factors average: 1.235
Type of Structure average: 1.235
Available Resources average: 0.600

Analysis of Completeness

User selection procedure was holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit	4(162.315), 25 (413.075)	5(178.005), 26 (423.165)	10(229.825)	14(272.475)
Size Up Factors	1(125.595), 9 (221.025), 18 (312.375), 23 (401.875)	6(188.065)	11(238.555)	15(279.275)
Type of Structure	2(137.775), 19 (340.045), 21 (386.535)	7(199.405), 20 (368.035)	12(247.825)	16(287.775)
Available Resources	3(152.405)	8(208.885)	13(257.345)	17(300.535)

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6LS041-DecisionResultsUpdated.xml

Final Choice

Ventilate through the roof (at: 165.539 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 67%
Horizontally Ventilate through a window: 33%

Dimensions
Risk/Benefit: 67%
Available Resources: 33%

Search Indices

Alternatives
Attack through main door average: 6.000
Horizontally Ventilate through a window average: 1.500

Dimensions
Risk/Benefit average: 6.000
Available Resources average: 1.500

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck
Risk/Benefit	1(64.779)	2(96.059)		
Size Up Factors				
Type of Structure				
Available Resources	3(124.399)			

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF042-DecisionResultsUpdated.xml

Final Choice

Attack through main door (at: 96.730 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Horizontally Ventilate through a window: 17%
Ventilate through the roof: 17%
Attack through main door: 67%

Dimensions
Risk/Benefit: 50%
Size Up Factors: 17%
Available Resources: 33%

Search Indices

Alternatives
Horizontally Ventilate through a window average: 0.600
Ventilate through the roof average: 0.600
Attack through main door average: 6.000

Dimensions
Risk/Benefit average: 3.000
Size Up Factors average: 0.600
Available Resources average: 1.500

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck	Attack through main door
Size Up Factors				1(21.840)
Type of Structure				
Available Resources				2(34.610), 3 (46.340)
Risk/Benefit	5(69.230)	6(85.300)		4(54.650)

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF043-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 189.120 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Ventilate through the roof: 33%
Ventilate from ladder truck: 33%
Attack through main door: 33%

Dimensions
Risk/Benefit: 33%
Size Up Factors: 33%
Type of Structure: 33%

Search Indices

Alternatives
Ventilate through the roof average: 1.500
Ventilate from ladder truck average: 1.500
Attack through main door average: 1.500

Dimensions
Risk/Benefit average: 1.500
Size Up Factors average: 1.500
Type of Structure average: 1.500

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Ventilate through the roof	**Ventilate from ladder truck**	**Attack through main door**	**Horizontally Ventilate through a window**
Type of Structure			1(136.000)	
Available Resources				
Risk/Benefit	2(158.000)			
Size Up Factors		3(167.320)		

Upload decision data

File: Browse... Upload

Decision Process Analysis Repo

Results of file:

6LS044-DecisionResultsUpdated.xml

Final Choice

Ventilate through the roof (at: 163.746 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Ventilate through the roof: 100%

Dimensions
Available Resources: 100%

Search Indices

Alternatives
Ventilate through the roof average: 1.000

Dimensions
Available Resources average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Ventilate from ladder truck	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof
Available Resources				1(158.626)
Risk/Benefit				
Size Up Factors				
Type of Structure				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6LS045-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 236.647 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Horizontally Ventilate through a window: 86%
Ventilate through the roof: 14%

Dimensions
Size Up Factors: 14%
Type of Structure: 29%
Available Resources: 43%
Risk/Benefit: 14%

Search Indices

Alternatives
Horizontally Ventilate through a window average: 18.000
Ventilate through the roof average: 0.500

Dimensions
Size Up Factors average: 0.500
Type of Structure average: 1.200
Available Resources average: 2.250
Risk/Benefit average: 0.500

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Horizontally Ventilate through a window	Ventilate through the roof	Ventilate from ladder truck	Attack through main door
Size Up Factors	1(131.587)			
Type of Structure	2(153.347), 4 (180.867)			
Available Resources	3(170.557), 7 (221.027)	6(205.767)		
Risk/Benefit	5(187.827)			

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF046-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 169.418 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Ventilate through the roof: 50%
Attack through main door: 50%

Dimensions
Available Resources: 50%
Type of Structure: 50%

Search Indices

Alternatives
Ventilate through the roof average: 3.000
Attack through main door average: 3.000

Dimensions
Available Resources average: 3.000
Type of Structure average: 3.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Ventilate through the roof	Ventilate from ladder truck	Attack through main door	Horizontally Ventilate through a window
Type of Structure			1(107.788)	
Available Resources	2(141.038)			
Risk/Benefit				
Size Up Factors				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6HF047-DecisionResultsUpdated.xml

Final Choice

Ventilate through the roof (at: 260.878 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack through main door: 25%
Horizontally Ventilate through a window: 25%
Ventilate through the roof: 50%

Dimensions
Risk/Benefit: 25%
Available Resources: 75%

Search Indices

Alternatives
Attack through main door average: 1.000
Horizontally Ventilate through a window average: 1.000
Ventilate through the roof average: 3.000

Dimensions
Risk/Benefit average: 1.000
Available Resources average: 9.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Ventilate from ladder truck	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof
Available Resources			3(228.618)	1(194.648), 4 (252.338)
Risk/Benefit		2(211.848)		
Size Up Factors				
Type of Structure				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6LS048-DecisionResultsUpdated.xml

Final Choice

Attack through main door (at: 170.381 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Horizontally Ventilate through a window: 29%
Ventilate through the roof: 29%
Ventilate from ladder truck: 14%
Attack through main door: 29%

Dimensions
Size Up Factors: 100%

Search Indices

Alternatives
Horizontally Ventilate through a window average: 1.200
Ventilate through the roof average: 1.200
Ventilate from ladder truck average: 0.500
Attack through main door average: 1.200

Dimensions
Size Up Factors average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Horizontally Ventilate through a window	**Ventilate through the roof**	**Ventilate from ladder truck**	**Attack through main door**
Size Up Factors	1(90.681), 5 (130.781)	2(101.381), 6 (142.201)	3(111.871)	4(122.321), 7 (159.541)
Type of Structure				
Available Resources				
Risk/Benefit				

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

6HF049-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 393.542 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Ventilate through the roof: 27%
Ventilate from ladder truck: 18%
Attack through main door: 36%
Horizontally Ventilate through a window: 18%

Dimensions
Type of Structure: 9%
Available Resources: 27%
Risk/Benefit: 45%
Size Up Factors: 18%

Search Indices

Alternatives
Ventilate through the roof average: 1.125
Ventilate from ladder truck average: 0.667
Attack through main door average: 1.714
Horizontally Ventilate through a window average: 0.667

Dimensions
Type of Structure average: 0.300
Available Resources average: 1.125
Risk/Benefit average: 2.500
Size Up Factors average: 0.667

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Ventilate through the roof	**Ventilate from ladder truck**	**Attack through main door**	**Horizontally Ventilate through a window**
Type of Structure	1(244.462)			
Available Resources	2(253.412)		4(276.242)	7(309.262)
Risk/Benefit	3(267.122)	9(337.252)	5(286.572), 11 (362.692)	8(322.872)
Size Up Factors		10(345.592)	6(294.902)	

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6LS050-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 253.785 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Ventilate from ladder truck: 25%
Attack through main door: 25%
Horizontally Ventilate through a window: 50%

Dimensions
Risk/Benefit: 13%
Size Up Factors: 38%
Type of Structure: 25%
Available Resources: 25%

Search Indices

Alternatives
Ventilate from ladder truck average: 1.000
Attack through main door average: 1.000
Horizontally Ventilate through a window average: 3.000

Dimensions
Risk/Benefit average: 0.429
Size Up Factors average: 1.800
Type of Structure average: 1.000
Available Resources average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Ventilate from ladder truck	Attack through main door	Horizontally Ventilate through a window	Ventilate through the roof
Available Resources			1(145.335), 8 (241.395)	
Risk/Benefit	5(205.745)			
Size Up Factors	3(174.065)	6(214.495)	2(162.015)	
Type of Structure		7(225.615)	4(186.445)	

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

6HFHF051-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 150.594 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Horizontally Ventilate through a window: 100%

Dimensions
Type of Structure: 33%
Available Resources: 33%
Risk/Benefit: 33%

Search Indices

Alternatives
Horizontally Ventilate through a window average: 1.000

Dimensions
Type of Structure average: 1.500
Available Resources average: 1.500
Risk/Benefit average: 1.500

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Horizontally Ventilate through a window	**Ventilate through the roof**	**Ventilate from ladder truck**	**Attack through main door**
Size Up Factors				
Type of Structure	1(108.054)			
Available Resources	3(133.104)			
Risk/Benefit	2(123.524)			

Upload decision data

File: Browse... Upload

Decision Process Analysis Repo

Results of file:

6LS052-DecisionResultsUpdated.xml

Final Choice

Ventilate through the roof (at: 145.541 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Ventilate through the roof: 100%

Dimensions
Available Resources: 100%

Search Indices

Alternatives
Ventilate through the roof average: 1.000

Dimensions
Available Resources average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Ventilate through the roof	Ventilate from ladder truck	Attack through main door	Horizontally Ventilate through a window
Type of Structure				
Available Resources	1(131.951)			
Risk/Benefit				
Size Up Factors				

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

6HF053-DecisionResultsUpdated.xml

Final Choice

Ventilate through the roof (at: 147.336 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Ventilate from ladder truck: 67%
Attack through main door: 33%

Dimensions
Size Up Factors: 33%
Type of Structure: 33%
Available Resources: 33%

Search Indices

Alternatives
Ventilate from ladder truck average: 6.000
Attack through main door average: 1.500

Dimensions
Size Up Factors average: 1.500
Type of Structure average: 1.500
Available Resources average: 1.500

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Ventilate from ladder truck	**Attack through main door**	**Horizontally Ventilate through a window**	**Ventilate through the roof**
Available Resources		1(107.776)		
Risk/Benefit				
Size Up Factors	2(123.956)			
Type of Structure	3(132.366)			

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

6LS054-DecisionResultsUpdated.xml

Final Choice

Ventilate through the roof (at: 246.278 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Horizontally Ventilate through a window: 75%
Ventilate through the roof: 25%

Dimensions
Size Up Factors: 25%
Available Resources: 25%
Risk/Benefit: 50%

Search Indices

Alternatives
Horizontally Ventilate through a window average: 9.000
Ventilate through the roof average: 1.000

Dimensions
Size Up Factors average: 1.000
Available Resources average: 1.000
Risk/Benefit average: 3.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Horizontally Ventilate through a window	**Ventilate through the roof**	**Ventilate from ladder truck**	**Attack through main door**
Size Up Factors	3(219.458)			
Type of Structure				
Available Resources	1(190.808)			
Risk/Benefit	2(205.508)	4(235.608)		

Upload decision data

File: [   ] Browse... Upload

Decision Process Analysis Report

Results of file:

6HF055-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 110.816 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Ventilate through the roof: 25%
Attack through main door: 25%
Horizontally Ventilate through a window: 50%

Dimensions
Type of Structure: 75%
Available Resources: 25%

Search Indices

Alternatives
Ventilate through the roof average: 1.000
Attack through main door average: 1.000
Horizontally Ventilate through a window average: 3.000

Dimensions
Type of Structure average: 9.000
Available Resources average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Ventilate through the roof	Ventilate from ladder truck	Attack through main door	Horizontally Ventilate through a window
Type of Structure	2(72.276)		1(44.286)	3(82.486)
Available Resources				4(91.416)
Risk/Benefit				
Size Up Factors				

Upload decision data

File: [   ] Browse... Upload

Decision Process Analysis Report

Results of file:

6LS056b-DecisionResultsUpdated.xml

Final Choice

Horizontally Ventilate through a window (at: 352.044 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Ventilate from ladder truck: 21%
Attack through main door: 26%
Horizontally Ventilate through a window: 26%
Ventilate through the roof: 26%

Dimensions
Available Resources: 26%
Risk/Benefit: 26%
Size Up Factors: 26%
Type of Structure: 21%

Search Indices

Alternatives
Ventilate from ladder truck average: 0.800
Attack through main door average: 1.071
Horizontally Ventilate through a window average: 1.071
Ventilate through the roof average: 1.071

Dimensions
Available Resources average: 1.071
Risk/Benefit average: 1.071
Size Up Factors average: 1.071
Type of Structure average: 0.800

Analysis of Completeness

User selection procedure was holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Ventilate from ladder truck	**Attack through main door**	**Horizontally Ventilate through a window**	**Ventilate through the roof**
Available Resources	17(289.274)	5(173.914)	6(184.804), 20 (333.814)	7(192.954)
Risk/Benefit	8(201.464)	9(207.374), 18 (308.134)	10(216.894)	11(226.634)
Size Up Factors	1(133.604)	2(144.174)	3(154.454)	4(162.344), 12 (235.354)
Type of Structure	16(275.304)	15(261.814)	14(252.434)	13(244.284)

Appendix E – Experiment 2 Decision Portraits

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Repo

Results of file:

7FG1_28_04-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 85.826 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack the Fire: 100%

Dimensions
Available Resources: 100%

Search Indices

Alternatives
Attack the Fire average: 1.000

Dimensions
Available Resources average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources			1(45.946)	
Size Up Factors				
Risk/Benefit				
Ventilation Factors				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

7FG2_28_04-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 112.349 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Cool the Environment: 20%
Attack the Fire: 80%

Dimensions
Available Resources: 40%
Size Up Factors: 20%
Risk/Benefit: 20%
Ventilation Factors: 20%

Search Indices

Alternatives
Cool the Environment average: 0.750
Attack the Fire average: 12.000

Dimensions
Available Resources average: 2.000
Size Up Factors average: 0.750
Risk/Benefit average: 0.750
Ventilation Factors average: 0.750

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	**Cool the Environment**	**Attack the Fire**	**Break Window**
Available Resources		1(73.559)	2(83.729)	
Size Up Factors			3(88.809)	
Risk/Benefit			4(94.699)	
Ventilation Factors			5(107.119)	

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

7FG3_28_04-DecisionResultsUpdated.xml

Final Choice

Back Out (at: 96.168 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Back Out: 40%
Cool the Environment: 20%
Attack the Fire: 20%
Break Window: 20%

Dimensions
Available Resources: 80%
Size Up Factors: 20%

Search Indices

Alternatives
Back Out average: 2.000
Cool the Environment average: 0.750
Attack the Fire average: 0.750
Break Window average: 0.750

Dimensions
Available Resources average: 12.000
Size Up Factors average: 0.750

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources	4(71.938)	3(58.318)	2(49.158)	1(43.588)
Size Up Factors	5(80.458)			
Risk/Benefit				
Ventilation Factors				

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

7FG4_28_04-DecisionResultsUpdated.xml

Final Choice

Break Window (at: 72.725 seconds)
Smoke level (inches from the floor): __

Selection Percentages

No Selections were made

Search Indices

No Selections were made

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources				
Size Up Factors				
Risk/Benefit				
Ventilation Factors				

Physiological Report

Blood Pressure

No data available

Heart Rate

No data available

Heart Rate Variability: HF/LF

No data available

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

7FG5_28_04-DecisionResultsUpdated.xml

Final Choice

Back Out (at: 102.284 seconds)
Smoke level (inches from the floor): __

Selection Percentages

No Selections were made

Search Indices

No Selections were made

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources				
Size Up Factors				
Risk/Benefit				
Ventilation Factors				

Physiological Report

Blood Pressure

No data available

Heart Rate

No data available

Heart Rate Variability: HF/LF

No data available

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

5FG6_19_05-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 54.884 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Cool the Environment: 33%
Attack the Fire: 67%

Dimensions
Available Resources: 67%
Ventilation Factors: 33%

Search Indices

Alternatives
Cool the Environment average: 1.500
Attack the Fire average: 6.000

Dimensions
Available Resources average: 6.000
Ventilation Factors average: 1.500

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources		1(10.854)	2(26.104)	
Size Up Factors				
Risk/Benefit				
Ventilation Factors			3(44.964)	

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8FG001_28_05-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 118.080 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Back Out: 33%
Attack the Fire: 67%

Dimensions
Ventilation Factors: 33%
Available Resources: 33%
Size Up Factors: 33%

Search Indices

Alternatives
Back Out average: 1.500
Attack the Fire average: 6.000

Dimensions
Ventilation Factors average: 1.500
Available Resources average: 1.500
Size Up Factors average: 1.500

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources			2(93.710)	
Size Up Factors			3(106.190)	
Risk/Benefit				
Ventilation Factors	1(78.800)			

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8FG002_28_05-DecisionResultsUpdated.xml

Final Choice

Back Out (at: 83.398 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Back Out: 100%

Dimensions
Available Resources: 25%
Size Up Factors: 25%
Risk/Benefit: 25%
Ventilation Factors: 25%

Search Indices

Alternatives
Back Out average: 1.000

Dimensions
Available Resources average: 1.000
Size Up Factors average: 1.000
Risk/Benefit average: 1.000
Ventilation Factors average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources	1(30.908)			
Size Up Factors	2(39.388)			
Risk/Benefit	3(47.488)			
Ventilation Factors	4(60.908)			

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

8FG003_28_05-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 73.848 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Cool the Environment: 40%
Attack the Fire: 60%

Dimensions
Available Resources: 40%
Size Up Factors: 40%
Risk/Benefit: 20%

Search Indices

Alternatives
Cool the Environment average: 2.000
Attack the Fire average: 4.500

Dimensions
Available Resources average: 2.000
Size Up Factors average: 2.000
Risk/Benefit average: 0.750

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources		1(25.518)	2(38.508)	
Size Up Factors		3(45.668)	4(51.618)	
Risk/Benefit			5(59.698)	
Ventilation Factors				

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

8FG004_28_05-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 44.193 seconds)
Smoke level (inches from the floor): __

Selection Percentages

No Selections were made

Search Indices

No Selections were made

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources				
Size Up Factors				
Risk/Benefit				
Ventilation Factors				

Physiological Report

Blood Pressure

No data available

Heart Rate

No data available

Heart Rate Variability: HF/LF

No data available

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

8FG005_28_05-DecisionResultsUpdated.xml

Final Choice

Back Out (at: 75.966 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Cool the Environment: 60%
Attack the Fire: 40%

Dimensions
Available Resources: 40%
Size Up Factors: 20%
Risk/Benefit: 40%

Search Indices

Alternatives
Cool the Environment average: 4.500
Attack the Fire average: 2.000

Dimensions
Available Resources average: 2.000
Size Up Factors average: 0.750
Risk/Benefit average: 2.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources		1(20.206)	3(35.356)	
Size Up Factors		2(30.036)		
Risk/Benefit		5(49.896)	4(42.186)	
Ventilation Factors				

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Repo

Results of file:

8FG006-DecisionResultsUpdated.xml

Final Choice

Cool the Environment (at: 33.298 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack the Fire: 100%

Dimensions
Available Resources: 100%

Search Indices

Alternatives
Attack the Fire average: 1.000

Dimensions
Available Resources average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources			1(21.228)	
Size Up Factors				
Risk/Benefit				
Ventilation Factors				

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Repo

Results of file:

8FG007-DecisionResultsUpdated.xml

Final Choice

Back Out (at: 85.105 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Cool the Environment: 50%
Attack the Fire: 50%

Dimensions
Available Resources: 100%

Search Indices

Alternatives
Cool the Environment average: 3.000
Attack the Fire average: 3.000

Dimensions
Available Resources average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources		2(80.065)	1(52.275)	
Size Up Factors				
Risk/Benefit				
Ventilation Factors				

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Repo

Results of file:

8FG008-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 72.710 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack the Fire: 100%

Dimensions
Available Resources: 50%
Risk/Benefit: 50%

Search Indices

Alternatives
Attack the Fire average: 1.000

Dimensions
Available Resources average: 3.000
Risk/Benefit average: 3.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources			1(43.150)	
Size Up Factors				
Risk/Benefit			2(53.430)	
Ventilation Factors				

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Repo

Results of file:

8FG009-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 38.292 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack the Fire: 100%

Dimensions
Available Resources: 50%
Size Up Factors: 50%

Search Indices

Alternatives
Attack the Fire average: 1.000

Dimensions
Available Resources average: 3.000
Size Up Factors average: 3.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources			1(15.732)	
Size Up Factors			2(25.902)	
Risk/Benefit				
Ventilation Factors				

Upload decision data

File: [Browse...] [Upload]

Decision Process Analysis Report

Results of file:

8LS010-DecisionResultsUpdated.xml

Final Choice

Back Out (at: 119.410 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Cool the Environment: 50%
Attack the Fire: 50%

Dimensions
Available Resources: 100%

Search Indices

Alternatives
Cool the Environment average: 3.000
Attack the Fire average: 3.000

Dimensions
Available Resources average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources		2(106.240)	1(99.080)	
Size Up Factors				
Risk/Benefit				
Ventilation Factors				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8LS011-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 80.950 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Back Out: 33%
Cool the Environment: 33%
Attack the Fire: 33%

Dimensions
Risk/Benefit: 33%
Available Resources: 67%

Search Indices

Alternatives
Back Out average: 1.500
Cool the Environment average: 1.500
Attack the Fire average: 1.500

Dimensions
Risk/Benefit average: 1.500
Available Resources average: 6.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources		1(18.260)	2(33.700)	
Size Up Factors				
Risk/Benefit	3(60.170)			
Ventilation Factors				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8LS012-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 146.412 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Back Out: 20%
Attack the Fire: 80%

Dimensions
Ventilation Factors: 60%
Available Resources: 20%
Risk/Benefit: 20%

Search Indices

Alternatives
Back Out average: 0.750
Attack the Fire average: 12.000

Dimensions
Ventilation Factors average: 4.500
Available Resources average: 0.750
Risk/Benefit average: 0.750

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	**Cool the Environment**	**Attack the Fire**	**Break Window**
Available Resources			1(47.902)	
Size Up Factors				
Risk/Benefit			6(115.512)	
Ventilation Factors	4 (84.192)		2(62.222), 3 (73.072)	

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8LS013-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 51.061 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack the Fire: 100%

Dimensions
Size Up Factors: 33%
Risk/Benefit: 33%
Ventilation Factors: 33%

Search Indices

Alternatives
Attack the Fire average: 1.000

Dimensions
Size Up Factors average: 1.500
Risk/Benefit average: 1.500
Ventilation Factors average: 1.500

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources				
Size Up Factors			1(23.051)	
Risk/Benefit			2(30.641)	
Ventilation Factors			3(39.941)	

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF014-DecisionResultsUpdated.xml

Final Choice

Break Window (at: 71.662 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Back Out: 25%
Cool the Environment: 25%
Break Window: 50%

Dimensions
Available Resources: 75%
Risk/Benefit: 25%

Search Indices

Alternatives
Back Out average: 1.000
Cool the Environment average: 1.000
Break Window average: 3.000

Dimensions
Available Resources average: 9.000
Risk/Benefit average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources	1(23.352)	2(31.892)		3(45.432)
Size Up Factors				
Risk/Benefit				4(57.022)
Ventilation Factors				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF015-DecisionResultsUpdated.xml

Final Choice

Cool the Environment (at: 40.380 seconds)
Smoke level (inches from the floor): __

Selection Percentages

No Selections were made

Search Indices

No Selections were made

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources				
Size Up Factors				
Risk/Benefit				
Ventilation Factors				

Physiological Report

Blood Pressure

No data available

Heart Rate

No data available

Heart Rate Variability: HF/LF

No data available

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF016-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 38.538 seconds)
Smoke level (inches from the floor): __

Selection Percentages

No Selections were made

Search Indices

No Selections were made

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources				
Size Up Factors				
Risk/Benefit				
Ventilation Factors				

Physiological Report

Blood Pressure

No data available

Heart Rate

No data available

Heart Rate Variability: HF/LF

No data available

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF017-DecisionResultsUpdated.xml

Final Choice

Back Out (at: 37.224 seconds)
Smoke level (inches from the floor): __

Selection Percentages

No Selections were made

Search Indices

No Selections were made

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources				
Size Up Factors				
Risk/Benefit				
Ventilation Factors				

Physiological Report

Blood Pressure

No data available

Heart Rate

No data available

Heart Rate Variability: HF/LF

No data available

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF018-DecisionResultsUpdated.xml

Final Choice

Break Window (at: 58.099 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack the Fire: 50%
Break Window: 50%

Dimensions
Risk/Benefit: 50%
Available Resources: 50%

Search Indices

Alternatives
Attack the Fire average: 3.000
Break Window average: 3.000

Dimensions
Risk/Benefit average: 3.000
Available Resources average: 3.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources				2(52.249)
Size Up Factors				
Risk/Benefit			1(40.519)	
Ventilation Factors				

Upload decision data

File: Browse... Upload

Decision Process Analysis Repo

Results of file:

8LS019-DecisionResultsUpdated.xml

Final Choice

Break Window (at: 32.022 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Break Window: 100%

Dimensions
Available Resources: 100%

Search Indices

Alternatives
Break Window average: 1.000

Dimensions
Available Resources average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources				1(21.172)
Size Up Factors				
Risk/Benefit				
Ventilation Factors				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF020-DecisionResultsUpdated.xml

Final Choice

Break Window (at: 47.559 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Cool the Environment: 50%
Break Window: 50%

Dimensions
Available Resources: 100%

Search Indices

Alternatives
Cool the Environment average: 3.000
Break Window average: 3.000

Dimensions
Available Resources average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources		1(30.119)		2(40.509)
Size Up Factors				
Risk/Benefit				
Ventilation Factors				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF021-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 19.144 seconds)
Smoke level (inches from the floor): __

Selection Percentages

No Selections were made

Search Indices

No Selections were made

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources				
Size Up Factors				
Risk/Benefit				
Ventilation Factors				

Physiological Report

Blood Pressure

No data available

Heart Rate

No data available

Heart Rate Variability: HF/LF

No data available

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF022-DecisionResultsUpdated.xml

Final Choice

Back Out (at: 49.730 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Back Out: 67%
Attack the Fire: 33%

Dimensions
Available Resources: 67%
Size Up Factors: 33%

Search Indices

Alternatives
Back Out average: 6.000
Attack the Fire average: 1.500

Dimensions
Available Resources average: 6.000
Size Up Factors average: 1.500

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	**Cool the Environment**	**Attack the Fire**	**Break Window**
Available Resources	1(19.920)		3(36.750)	
Size Up Factors	2(27.390)			
Risk/Benefit				
Ventilation Factors				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF023-DecisionResultsUpdated.xml

Final Choice

Cool the Environment (at: 54.820 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Back Out: 25%
Cool the Environment: 50%
Attack the Fire: 25%

Dimensions
Available Resources: 100%

Search Indices

Alternatives
Back Out average: 1.000
Cool the Environment average: 3.000
Attack the Fire average: 1.000

Dimensions
Available Resources average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	**Cool the Environment**	**Attack the Fire**	**Break Window**
Available Resources	1(16.090)	3(31.130), 4(36.480)	2(21.290)	
Size Up Factors				
Risk/Benefit				
Ventilation Factors				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF024-DecisionResultsUpdated.xml

Final Choice

Break Window (at: 96.574 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Back Out: 33%
Attack the Fire: 33%
Break Window: 33%

Dimensions
Ventilation Factors: 67%
Available Resources: 33%

Search Indices

Alternatives
Back Out average: 1.500
Attack the Fire average: 1.500
Break Window average: 1.500

Dimensions
Ventilation Factors average: 6.000
Available Resources average: 1.500

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	**Cool the Environment**	**Attack the Fire**	**Break Window**
Available Resources			1(21.064)	
Size Up Factors				
Risk/Benefit				
Ventilation Factors	2(72.074)			3(86.944)

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF025-DecisionResultsUpdated.xml

Final Choice

Break Window (at: 116.934 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Cool the Environment: 50%
Break Window: 50%

Dimensions
Available Resources: 33%
Size Up Factors: 33%
Ventilation Factors: 33%

Search Indices

Alternatives
Cool the Environment average: 3.000
Break Window average: 3.000

Dimensions
Available Resources average: 1.500
Size Up Factors average: 1.500
Ventilation Factors average: 1.500

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	**Cool the Environment**	**Attack the Fire**	**Break Window**
Available Resources		1(43.954)		4(91.944)
Size Up Factors		2(65.354)		5(97.314)
Risk/Benefit				
Ventilation Factors		3(74.854)		6(106.384)

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF026-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 131.358 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Cool the Environment: 33%
Attack the Fire: 33%
Break Window: 33%

Dimensions
Available Resources: 25%
Size Up Factors: 25%
Risk/Benefit: 25%
Ventilation Factors: 25%

Search Indices

Alternatives
Cool the Environment average: 1.500
Attack the Fire average: 1.500
Break Window average: 1.500

Dimensions
Available Resources average: 1.000
Size Up Factors average: 1.000
Risk/Benefit average: 1.000
Ventilation Factors average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources		5(60.898)	9(98.908)	1(23.908)
Size Up Factors		6(75.208)	10(104.988)	2(33.758)
Risk/Benefit		7(82.478)	11(111.758)	3(43.678)
Ventilation Factors		8(89.168)	12(120.088)	4(49.088)

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF027-DecisionResultsUpdated.xml

Final Choice

Back Out (at: 44.141 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Back Out: 67%
Cool the Environment: 33%

Dimensions
Available Resources: 33%
Ventilation Factors: 33%
Risk/Benefit: 33%

Search Indices

Alternatives
Back Out average: 6.000
Cool the Environment average: 1.500

Dimensions
Available Resources average: 1.500
Ventilation Factors average: 1.500
Risk/Benefit average: 1.500

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	**Cool the Environment**	**Attack the Fire**	**Break Window**
Available Resources	3(41.181)			
Size Up Factors				
Risk/Benefit		1(16.601)		
Ventilation Factors	2(34.071)			

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF028-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 142.490 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Back Out: 17%
Attack the Fire: 67%
Break Window: 17%

Dimensions
Ventilation Factors: 50%
Available Resources: 17%
Size Up Factors: 17%
Risk/Benefit: 17%

Search Indices

Alternatives
Back Out average: 0.600
Attack the Fire average: 6.000
Break Window average: 0.600

Dimensions
Ventilation Factors average: 3.000
Available Resources average: 0.600
Size Up Factors average: 0.600
Risk/Benefit average: 0.600

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	**Cool the Environment**	**Attack the Fire**	**Break Window**
Available Resources			6(125.540)	
Size Up Factors			5(120.820)	
Risk/Benefit			4(109.610)	
Ventilation Factors	1(65.750)		2(80.050)	3(91.270)

Upload decision data

File: Browse... Upload

Decision Process Analysis Repo

Results of file:

8HF029-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 30.320 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack the Fire: 100%

Dimensions
Size Up Factors: 100%

Search Indices

Alternatives
Attack the Fire average: 1.000

Dimensions
Size Up Factors average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Cool the Environment	Attack the Fire	Break Window	Back Out
Size Up Factors		1(16.060)		
Risk/Benefit				
Ventilation Factors				
Available Resources				

Upload decision data

File: Browse... Upload

Decision Process Analysis Repo

Results of file:

8HF030-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 24.507 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack the Fire: 100%

Dimensions
Risk/Benefit: 100%

Search Indices

Alternatives
Attack the Fire average: 1.000

Dimensions
Risk/Benefit average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack the Fire	Break Window	Back Out	Cool the Environment
Risk/Benefit	1(18.557)			
Ventilation Factors				
Available Resources				
Size Up Factors				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF031-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 29.634 seconds)
Smoke level (inches from the floor): __

Selection Percentages

No Selections were made

Search Indices

No Selections were made

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Break Window	Back Out	Cool the Environment	Attack the Fire
Ventilation Factors				
Available Resources				
Size Up Factors				
Risk/Benefit				

Physiological Report

Blood Pressure

No data available

Heart Rate

No data available

Heart Rate Variability: HF/LF

No data available

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF032-DecisionResultsUpdated.xml

Final Choice

Cool the Environment (at: 86.968 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Cool the Environment: 67%
Attack the Fire: 33%

Dimensions
Size Up Factors: 17%
Risk/Benefit: 33%
Ventilation Factors: 17%
Available Resources: 33%

Search Indices

Alternatives
Cool the Environment average: 6.000
Attack the Fire average: 1.500

Dimensions
Size Up Factors average: 0.600
Risk/Benefit average: 1.500
Ventilation Factors average: 0.600
Available Resources average: 1.500

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Cool the Environment	Attack the Fire	Break Window	Back Out
Size Up Factors	3(56.328)			
Risk/Benefit	4(61.418)	1(27.268)		
Ventilation Factors	5(67.568)			
Available Resources	6(77.458)	2(41.948)		

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF033-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 104.520 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack the Fire: 75%
Cool the Environment: 25%

Dimensions
Risk/Benefit: 25%
Ventilation Factors: 50%
Available Resources: 25%

Search Indices

Alternatives
Attack the Fire average: 9.000
Cool the Environment average: 1.000

Dimensions
Risk/Benefit average: 1.000
Ventilation Factors average: 3.000
Available Resources average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack the Fire	Break Window	Back Out	Cool the Environment
Risk/Benefit	1(16.810)			
Ventilation Factors	4(92.960)			2(41.280)
Available Resources	3(88.140)			
Size Up Factors				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF034-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 67.789 seconds)
Smoke level (inches from the floor): __

Selection Percentages

No Selections were made

Search Indices

No Selections were made

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Break Window	Back Out	Cool the Environment	Attack the Fire
Ventilation Factors				
Available Resources				
Size Up Factors				
Risk/Benefit				

Physiological Report

Blood Pressure

No data available

Heart Rate

No data available

Heart Rate Variability: HF/LF

No data available

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF035-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 54.666 seconds)
Smoke level (inches from the floor): __

Selection Percentages

No Selections were made

Search Indices

No Selections were made

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Cool the Environment	Attack the Fire	Break Window	Back Out
Size Up Factors				
Risk/Benefit				
Ventilation Factors				
Available Resources				

Physiological Report

Blood Pressure

No data available

Heart Rate

No data available

Heart Rate Variability: HF/LF

No data available

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF036-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 85.285 seconds)
Smoke level (inches from the floor): __

Selection Percentages

No Selections were made

Search Indices

No Selections were made

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack the Fire	Break Window	Back Out	Cool the Environment
Risk/Benefit				
Ventilation Factors				
Available Resources				
Size Up Factors				

Physiological Report

Blood Pressure

No data available

Heart Rate

No data available

Heart Rate Variability: HF/LF

No data available

Upload decision data

File: Browse... Upload

Decision Process Analysis Repo

Results of file:

8LS037-DecisionResultsUpdated.xml

Final Choice

Break Window (at: 50.521 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Break Window: 100%

Dimensions
Risk/Benefit: 100%

Search Indices

Alternatives
Break Window average: 1.000

Dimensions
Risk/Benefit average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources				
Size Up Factors				
Risk/Benefit				1(31.161)
Ventilation Factors				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF038-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 17.269 seconds)
Smoke level (inches from the floor): __

Selection Percentages

No Selections were made

Search Indices

No Selections were made

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Cool the Environment	Attack the Fire	Break Window	Back Out
Size Up Factors				
Risk/Benefit				
Ventilation Factors				
Available Resources				

Physiological Report

Blood Pressure

No data available

Heart Rate

No data available

Heart Rate Variability: HF/LF

No data available

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8LS039-DecisionResultsUpdated.xml

Final Choice

Back Out (at: 400.358 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Back Out: 20%
Cool the Environment: 20%
Attack the Fire: 40%
Break Window: 20%

Dimensions
Available Resources: 20%
Risk/Benefit: 40%
Ventilation Factors: 20%
Size Up Factors: 20%

Search Indices

Alternatives
Back Out average: 0.750
Cool the Environment average: 0.750
Attack the Fire average: 2.000
Break Window average: 0.750

Dimensions
Available Resources average: 0.750
Risk/Benefit average: 2.000
Ventilation Factors average: 0.750
Size Up Factors average: 0.750

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	**Cool the Environment**	**Attack the Fire**	**Break Window**
Available Resources	1 (266.638)		10(381.768)	
Size Up Factors			9(374.228)	3(290.858)
Risk/Benefit	4 (301.578)	5(317.468)	8(364.518)	2(280.058)
Ventilation Factors		6(339.738)	7(354.428)	

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8LS040-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 54.182 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack the Fire: 100%

Dimensions
Available Resources: 50%
Size Up Factors: 50%

Search Indices

Alternatives
Attack the Fire average: 1.000

Dimensions
Available Resources average: 3.000
Size Up Factors average: 3.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	**Cool the Environment**	**Attack the Fire**	**Break Window**
Available Resources			1(30.272)	
Size Up Factors			2(38.412)	
Risk/Benefit				
Ventilation Factors				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8LS041-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 29.786 seconds)
Smoke level (inches from the floor): __

Selection Percentages

No Selections were made

Search Indices

No Selections were made

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Back Out	Cool the Environment	Attack the Fire	Break Window
Available Resources				
Size Up Factors				
Risk/Benefit				
Ventilation Factors				

Physiological Report

Blood Pressure

No data available

Heart Rate

No data available

Heart Rate Variability: HF/LF

No data available

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF042-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 32.222 seconds)
Smoke level (inches from the floor): __

Selection Percentages

No Selections were made

Search Indices

No Selections were made

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Cool the Environment	Attack the Fire	Break Window	Back Out
Size Up Factors				
Risk/Benefit				
Ventilation Factors				
Available Resources				

Physiological Report

Blood Pressure

No data available

Heart Rate

No data available

Heart Rate Variability: HF/LF

No data available

Upload decision data

File: Browse... Upload

Decision Process Analysis Repo

Results of file:

8HF043-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 30.297 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack the Fire: 100%

Dimensions
Available Resources: 100%

Search Indices

Alternatives
Attack the Fire average: 1.000

Dimensions
Available Resources average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack the Fire	Break Window	Back Out	Cool the Environment
Risk/Benefit				
Ventilation Factors				
Available Resources	1(23.197)			
Size Up Factors				

Upload decision data

File: Browse... Upload

Decision Process Analysis Repo

Results of file:

8LS044-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 32.134 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack the Fire: 100%

Dimensions
Ventilation Factors: 100%

Search Indices

Alternatives
Attack the Fire average: 1.000

Dimensions
Ventilation Factors average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Break Window	Back Out	Cool the Environment	Attack the Fire
Ventilation Factors				1(26.884)
Available Resources				
Size Up Factors				
Risk/Benefit				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8LS045-DecisionResultsUpdated.xml

Final Choice

Back Out (at: 81.078 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Cool the Environment: 67%
Back Out: 33%

Dimensions
Size Up Factors: 67%
Risk/Benefit: 33%

Search Indices

Alternatives
Cool the Environment average: 6.000
Back Out average: 1.500

Dimensions
Size Up Factors average: 6.000
Risk/Benefit average: 1.500

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Cool the Environment	Attack the Fire	Break Window	Back Out
Size Up Factors	1(50.818)			3(72.468)
Risk/Benefit	2(59.118)			
Ventilation Factors				
Available Resources				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF046-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 27.946 seconds)
Smoke level (inches from the floor): __

Selection Percentages

No Selections were made

Search Indices

No Selections were made

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack the Fire	Break Window	Back Out	Cool the Environment
Risk/Benefit				
Ventilation Factors				
Available Resources				
Size Up Factors				

Physiological Report

Blood Pressure

No data available

Heart Rate

No data available

Heart Rate Variability: HF/LF

No data available

Upload decision data

File: Browse... Upload

Decision Process Analysis Repo

Results of file:

8HF047-DecisionResultsUpdated.xml

Final Choice

Back Out (at: 78.912 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack the Fire: 100%

Dimensions
Available Resources: 50%
Risk/Benefit: 50%

Search Indices

Alternatives
Attack the Fire average: 1.000

Dimensions
Available Resources average: 3.000
Risk/Benefit average: 3.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Break Window	Back Out	Cool the Environment	Attack the Fire
Ventilation Factors				
Available Resources				1(44.892)
Size Up Factors				
Risk/Benefit				2(64.842)

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8LS048-DecisionResultsUpdated.xml

Final Choice

Cool the Environment (at: 163.842 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Cool the Environment: 67%
Break Window: 33%

Dimensions
Size Up Factors: 67%
Risk/Benefit: 33%

Search Indices

Alternatives
Cool the Environment average: 6.000
Break Window average: 1.500

Dimensions
Size Up Factors average: 6.000
Risk/Benefit average: 1.500

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Cool the Environment	**Attack the Fire**	**Break Window**	**Back Out**
Size Up Factors	1(81.882)		3(108.182)	
Risk/Benefit	2(87.292)			
Ventilation Factors				
Available Resources				

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8HF049-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 313.879 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack the Fire: 50%
Break Window: 25%
Cool the Environment: 25%

Dimensions
Available Resources: 75%
Size Up Factors: 25%

Search Indices

Alternatives
Attack the Fire average: 3.000
Break Window average: 1.000
Cool the Environment average: 1.000

Dimensions
Available Resources average: 9.000
Size Up Factors average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack the Fire	Break Window	Back Out	Cool the Environment
Risk/Benefit				
Ventilation Factors				
Available Resources	1(268.639)	4(303.329)		2(279.979)
Size Up Factors	3(292.729)			

Upload decision data

File: Browse... Upload

Decision Process Analysis Report

Results of file:

8LS050-DecisionResultsUpdated.xml

Final Choice

Back Out (at: 126.313 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Back Out: 71%
Cool the Environment: 29%

Dimensions
Ventilation Factors: 57%
Available Resources: 14%
Risk/Benefit: 14%
Size Up Factors: 14%

Search Indices

Alternatives
Back Out average: 7.500
Cool the Environment average: 1.200

Dimensions
Ventilation Factors average: 4.000
Available Resources average: 0.500
Risk/Benefit average: 0.500
Size Up Factors average: 0.500

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Break Window	Back Out	Cool the Environment	Attack the Fire
Ventilation Factors		3(72.013), 5(92.353), 7(117.553)	1(48.733)	
Available Resources		4(84.793)		
Size Up Factors			2(63.453)	
Risk/Benefit		6(107.733)		

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

8HFHF051-DecisionResultsUpdated.xml

Final Choice

Back Out (at: 62.202 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Break Window: 75%
Back Out: 25%

Dimensions
Size Up Factors: 50%
Risk/Benefit: 25%
Ventilation Factors: 25%

Search Indices

Alternatives
Break Window average: 9.000
Back Out average: 1.000

Dimensions
Size Up Factors average: 3.000
Risk/Benefit average: 1.000
Ventilation Factors average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Cool the Environment	Attack the Fire	Break Window	Back Out
Size Up Factors			1(19.692)	4(53.352)
Risk/Benefit			2(29.722)	
Ventilation Factors			3(43.012)	
Available Resources				

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Repo

Results of file:

8LS052-DecisionResultsUpdated.xml

Final Choice

Break Window (at: 153.976 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Break Window: 100%

Dimensions
Risk/Benefit: 100%

Search Indices

Alternatives
Break Window average: 1.000

Dimensions
Risk/Benefit average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack the Fire	Break Window	Back Out	Cool the Environment
Risk/Benefit		1(139.546)		
Ventilation Factors				
Available Resources				
Size Up Factors				

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

8HF053-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 29.883 seconds)
Smoke level (inches from the floor): __

Selection Percentages

No Selections were made

Search Indices

No Selections were made

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Break Window	Back Out	Cool the Environment	Attack the Fire
Ventilation Factors				
Available Resources				
Size Up Factors				
Risk/Benefit				

Physiological Report

Blood Pressure

No data available

Heart Rate

No data available

Heart Rate Variability: HF/LF

No data available

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Repo

Results of file:

8LS054-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 49.295 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack the Fire: 100%

Dimensions
Size Up Factors: 100%

Search Indices

Alternatives
Attack the Fire average: 1.000

Dimensions
Size Up Factors average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Cool the Environment	Attack the Fire	Break Window	Back Out
Size Up Factors		1(26.575)		
Risk/Benefit				
Ventilation Factors				
Available Resources				

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Repo

Results of file:

8HF055-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 55.491 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Attack the Fire: 100%

Dimensions
Size Up Factors: 100%

Search Indices

Alternatives
Attack the Fire average: 1.000

Dimensions
Size Up Factors average: 1.000

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Attack the Fire	Break Window	Back Out	Cool the Environment
Risk/Benefit				
Ventilation Factors				
Available Resources				
Size Up Factors	1(45.371)			

Upload decision data

File: [ ] Browse... Upload

Decision Process Analysis Report

Results of file:

8LS056b-DecisionResultsUpdated.xml

Final Choice

Attack the Fire (at: 150.412 seconds)
Smoke level (inches from the floor): __

Selection Percentages

Alternatives
Cool the Environment: 50%
Attack the Fire: 50%

Dimensions
Available Resources: 33%
Size Up Factors: 33%
Risk/Benefit: 33%

Search Indices

Alternatives
Cool the Environment average: 3.000
Attack the Fire average: 3.000

Dimensions
Available Resources average: 1.500
Size Up Factors average: 1.500
Risk/Benefit average: 1.500

Analysis of Completeness

User selection procedure was not holistic

Selection Flow

Legend: number in selection sequence(time of selection)

	Break Window	Back Out	Cool the Environment	Attack the Fire
Ventilation Factors				
Available Resources			1(29.232)	2(42.862)
Size Up Factors			4(62.012)	3(54.272)
Risk/Benefit			6(81.622)	5(71.822)

Appendix F –Matrices

PRE-BACKDRAFT DECISION SCENARIO

	Attack through main door	Horizontally ventilate through a window	Ventilate through the roof	Vertically ventilate from an aerial platform ladder truck
Risk/ Benefit	B11 Command from Engine 1, we'll enter through the front door, but we're concerned it might cause a backdraft.	B12 Command from Engine 2, the windows are so black, we can't see the seat of the fire. We'll open an upper window for ventilation, but we're concerned it might cause a backdraft.	B13 Command from Rescue 3, we're unsure of the condition of the roof, but vertical ventilation should help reduce the chances of a backdraft.	B14 Command from Platform 3, we're still at least 10 minutes out, but we'll respond for vertical ventilation.
Size Up Factors	B21 Command from Engine 1, it looks like the quickest way to the seat of the fire is by entering through the front door, but the need for forcible entry may require extra time.	B22 Command from Engine 2, there's not much of a cross breeze, so breaking some windows may not provide enough air movement for effective natural ventilation.	B23 Command from Rescue 3, there's an in-ground pool in the back that we'll have to work around, but we should be able to ladder the structure for vertical ventilation.	B24 Command from Platform 3, if we perform vertical ventilation, there won't be time or extra personnel available for us to perform a rescue.
Type of Structure	B31 Command from Engine 1, these homes are very energy efficient and this home looks pretty air tight. If we enter through the front door we may introduce oxygen to the fire.	B32 Command from Engine 2, we're aware that these homes are all built with lightweight wooden trusses, so there are several windows we could break for horizontal ventilation.	B33 Command from Rescue 3, you know these homes are built with lightweight wood truss construction, and may collapse shortly because of the fire.	B34 Command from Platform 3, If we use the platform for vertical ventilation, we won't have to place any firefighters on the roof, over the lightweight wood trusses.
Available Resources	B41 Command from Engine 1: it's only you and the two of us. That means that we will not meet two-in/two-out	B42 Command from Engine 1: we should be able to complete horizontal ventilation through the window with our crew of two	B43 Command from Engine 1: we need more firefighters for roof ventilation. It will be very difficult with the staff we have now. If you want, I can send the truck's crew up top when they get here in 20 minutes.	B44 Command from Engine 1: We can't perform the aerial platform roof operations without the truck and they won't be here for 20 minutes.

PRE-FLASHOVER SCENARIO

DIMENSIONS	ALTERNATIVES			
	Back Out	**Cool the Environment**	**Attack the Fire**	**Break Window**
Available Resources	F11 Command from Engine 2, we were delayed by a train, so you will not have a Rapid Intervention Team for about 10 more minutes.	F12 Command from Engine 1 operator, FF Jones was unable to make the hydrant and Engine 2 is still 10 minutes out. You'll only have the 500 gallons on the engine to help cool the interior.	F13 Command from Engine 1 operator, without a hydrant I don't know if the 500 gallons on our engine will be enough. Engine 2 is still 10 minutes out.	F14 Command from FF Jones, I have the tools to break a window right now.
Size Up Factors	F21 Command from Engine 1, it looks like the smoke is getting more dense from out here, you should consider backing out.	F22 Command from FF Jones, the heat is really starting to build up in here – my ears are starting to burn.	F23 Command from FF Jones, if we attack the fire directly, we may get a quick knockdown and reduce our chances for a rekindle.	F24 Command from FF Jones, it's windy, with about a 15 mph breeze at my back which will help cool the interior, yet we have to be aware of a flashover.
Risk/Benefit	F31 Command from Engine 1 operator, if we back out of here, we need to consider the front door which is too busted up from forcible entry to shut. Allowing air to freely enter the fire may lead to a flashover.	F32 Command from FF Jones, we won't have water long without a hydrant and just 500 gallons on the engine. If I flow water, it'll cool it down in here, but also disrupt the thermal layering, so we won't have any visibility for search and rescue, and we might get steam burns.	F33 Command from FF Jones, if there are any victims in the back bedrooms, they just may have a chance if we place the hoseline between the victim and the fire.	F34 Command from FF Jones, I'd sure like to bust that window to clear all this thick black smoke. It'll make it cooler in here and allow us to see better, but also might introduce oxygen and cause a flashover.
Ventilation Factors	F41 Command from Engine 1 operator, if you back out of the structure, I'll place a positive pressure fan in the front door. This should improve visibility, but it won't help any victims' chances.	F42 Command from FF Jones, I could flow a fog stream to help cool the interior, but it will disrupt the thermal layering, without some other ventilation,	F43 Command from Engine 1 operator, I should be able to coordinate horizontal or positive pressure ventilation with fire attack.	F44 Command from FF Jones, I remember a window on the leeward side and with the moderate breeze that was at my back when we came in. Breaking it may improve visibility.

Appendix G – Post Experiment Focus Group Questionnaire

Name of Moderator____________________

Date______________________________

Attendees____

____

Utilizing Virtual Reality Environments to Evaluate Firefighter Decision Making

Objective: Obtaining environmental ecological validity from experienced firefighters/incident commanders.

Workshop Participants: Dr. Nir Keren, Shawn Bayouth, Ross Bohner, Niyanth Kudumula

Introduction

Give an explanation

Good afternoon. My name is _______ and this is my colleague ______.
Thank you for coming. A focus group is a relaxed discussion.....

Present the purpose

We are here today to talk about your virtual reality experiences since you participated in the virtual reality firefighting environment. The purpose is to get your perceptions of how realistic and immersive the environments were. I am not here to share information, or to give you my opinions. Your perceptions are what matter. There are no right/wrong or desirable/undesirable answers. You can disagree with each other, and you can change your mind. I would like you to feel comfortable saying what you really think and how you really feel.

Discuss procedure

______ (colleague) *will be taking notes and/or video tape recording the discussion so that I do not miss anything you have to say. I explained these procedures to you when we set up this meeting. As you know everything is confidential. No one will know who said what. I want this to be a group discussion, so feel free to respond to me and to other members in the group without waiting to be called on. However, I would appreciate it if only one person did talk at a time. The discussion will last approximately one hour. There is a lot I want to discuss, so at times I may move us along a bit.*

Participant introduction

Now, let's start by everyone sharing their name, what position you currently hold, and how long they've been in the fire service.

Rapport building

I want each of you to think of an adjective that best describes your overall feelings following the virtual reality experience. We're going to go around the room so you can share your choices. Please briefly explain why you selected the adjective(s) you did.

Interview

Describe how natural/unnatural did moving through the environment feel to you?

Probes: *Tell me more about that. Why do you feel that way?*

Did the scenarios effectively represent decisions made in real-life firefighting?

Probes: *Why do you say that? What might have (helped, hurt) this more?*

How much time pressure did you experience due to the rate or pace at which the tasks occurred?

Probes: *Was that amount sufficient? Tell me what specifically made you feel that way?*

How familiar were you with the scenarios? Are these common in the fire service?

Probes: *Tell me more about that.*

How good was the information you received from the audio? Was the knowledge communicated realistic? Informative? Useful?

Probes: *What makes you say that?*

How successful do you think you were in accomplishing the goals of the task set by the experimenter (or yourself)? How satisfied were you with your performance in accomplishing these goals?

Probes: *That's interesting. Tell me more about that.*

Describe any feelings you may have felt during the tasks (e.g., insecure, discouraged, irritated, stressed, and annoyed versus secure, gratified, content, relaxed and complacent)?

Probes: *That's interesting, tell me more about that.*

If you could change one thing about the entire experience, what would that be?

Probes: *Tell me why you think they would be effective.*

Can you think of other scenarios that may be of interest to you to see in the virtual reality environment?

> Probes: *Where would you have gotten this information? How would the information have been different?*

If you were designing virtual reality scenrios in the future, how would you improve them?

> Probes: *Any ideas of how to best do that?*

After going through this experiment, what areas do you feel you need more training in?

> Probes: *Why do you say that? What would be the best avenue(s) for receiving that training?*

Closure

Though there were many different opinions about ________, it appears unanimous that ________. Does anyone see it differently? It seems most of you agree _______, but some think that ______. Does anyone want to add or clarify an opinion on this?

Is there any other information regarding your experience with or following the virtual reality environment that you think would be useful for me to know?

Thank you very much for coming this afternoon. Your time is very much appreciated and your comments have been very helpful.

Appendix H – Completed Surveys

Firefighter Focus Group SurveyMonkey

1. Please enter your assigned participant code for this study.

	Response Count
	62
answered question	62
skipped question	0

2. Would you like to continue with the survey?

	Response Percent	Response Count
Yes	100.0%	62
No	0.0%	0
answered question		62
skipped question		0

3. What is your gender?

	Response Percent	Response Count
Male	98.4%	61
Female	1.6%	1
answered question		62
skipped question		0

4. What is your primary race/heritage?

	Response Percent	Response Count
Caucasian	**95.2%**	**59**
African-American	0.0%	0
Asian	0.0%	0
Hispanic	3.2%	2
Other	1.6%	1
answered question		**62**
skipped question		**0**

5. What is your age?

	Response Percent	Response Count
18-25	9.7%	6
26-30	9.7%	6
31-35	17.7%	11
36-40	16.1%	10
41-45	**21.0%**	**13**
46-50	11.3%	7
51-55	8.1%	5
56-60	4.8%	3
60+	1.6%	1
answered question		**62**
skipped question		**0**

6. What is you education level?

	Response Percent	Response Count
High school	0.0%	0
Some college	33.9%	21
Associate of Arts/Science	25.8%	16
Bachelor of Arts/Science	**35.5%**	**22**
Graduate degree or graduate classes	4.8%	3
	answered question	**62**
	skipped question	**0**

7. You primarily perform the duties of firefighter as a (please check one)

	Response Percent	Response Count
Volunteer	0.0%	0
Career	**100.0%**	**62**
	answered question	**62**
	skipped question	**0**

8. What is your current rank?

	Response Percent	Response Count
Fire Chief	9.7%	6
Deputy Chief	4.8%	3
Assistant Chief	1.6%	1
District Chief	3.2%	2
Captain	4.8%	3
Lieutenant	12.9%	8
Firefighter	**61.3%**	**38**
Other	1.6%	1
answered question		**62**
skipped question		**0**

9. How many total years of experience do you have in the fire service?

Years

	1	2	3	4	5	6	7	8
Total Experience	0.0% (0)	2.1% (1)	2.1% (1)	4.3% (2)	2.1% (1)	2.1% (1)	4.3% (2)	6.4% (3)

10. Of that experience, how many years have been as a:

Years

	1	2	3	4	5	6	7	8
Volunteer	0.0% (0)	**25.0% (6)**	12.5% (3)	0.0% (0)	16.7% (4)	8.3% (2)	8.3% (2)	0.0% (0)
Career	2.1% (1)	4.3% (2)	8.5% (4)	2.1% (1)	4.3% (2)	2.1% (1)	6.4% (3)	**10.6% (5)**

11. Do you have experience as an on-scene Incident Commander?

	Response Percent	Response Count
Yes	**62.9%**	**39**
No	37.1%	23
	answered question	**62**
	skipped question	**0**

12. Please describe your incident command experience in terms of years of primary job respo

Years

	1	2	3	4	5	6	7	8
Incident Command Experience	**25.9% (7)**	11.1% (3)	7.4% (2)	0.0% (0)	7.4% (2)	0.0% (0)	7.4% (2)	0.0% (0)

13. Please rate the level of time pressure you experienced in this scenario:

	Absolutely no time pressure	Very light time pressure	Light time pressure	Moderate time pressure	Somewhat high time pressure	High time pressure	Very high time pressure
Amount of time pressure	0.0% (0)	12.0% (3)	8.0% (2)	**40.0% (10)**	20.0% (5)	16.0% (4)	4.0% (1)
							answered question
							skipped question

14. In this fire scenario, were there people in the house?

	Response Percent	Response Count
Absolutely not	1.6%	1
It is very unlikely that people were in the house	11.3%	7
It is unlikely that people were in the house	25.8%	16
It is likely that people were in the house	**45.2%**	**28**
It is very likely that people were in the house	16.1%	10
Absolutely	0.0%	0
	answered question	**62**
	skipped question	**0**

15. Please explain why you selected the option for the previous question.

	Response Count
	59
answered question	**59**
skipped question	**3**

16. This fire scenario was indicative of a(n):

	Response Percent	Response Count
Incipient fire	25.8%	16
Pre-backdraft	**50.0%**	**31**
Backdraft	6.5%	4
Pre-flashover	16.1%	10
Flashover	0.0%	0
Post-flashover	1.6%	1
answered question		**62**
skipped question		**0**

17. Please rate the level of time pressure you experienced in this scenario:

	Absolutely no time pressure	Very light time pressure	Light time pressure	Moderate time pressure	Somewhat high time pressure	High time pressure	Very high time pressure
Amount of time pressure	2.9% (1)	8.6% (3)	8.6% (3)	17.1% (6)	**31.4% (11)**	**31.4% (11)**	0.0% (0)
							answered question
							skipped question

18. The second fire scenario (inside the structure) was indicative of a(n):

	Response Percent	Response Count
Incipient fire	**45.2%**	**28**
Pre-backdraft	9.7%	6
Backdraft	0.0%	0
Pre-flashover	43.5%	27
Flashover	1.6%	1
Post-flashover	0.0%	0
	answered question	**62**
	skipped question	**0**

19. Which of the following best describes your level of training in fire behavior?

	Response Percent	Response Count
No formal training	0.0%	0
Approximately one training session every five years	6.5%	4
Approximately one training session every other year	11.3%	7
Annually	27.4%	17
Two or more trainings a year	**54.8%**	**34**
	answered question	**62**
	skipped question	**0**

20. Please provide a rough estimation of the number of times you have been engaged in real life in each one of the following firefighting scenarios (do not include training props):

	Never	A few (less than 4 times)	Several (4 to 10times)	Many (10 to 30 times)	Large number (more than 30 times)	Response Count
Pre-backdraft	37.1% (23)	**41.9% (26)**	6.5% (4)	9.7% (6)	4.8% (3)	62
Backdraft	**83.9% (52)**	12.9% (8)	1.6% (1)	0.0% (0)	1.6% (1)	62
Rollover	9.7% (6)	**37.1% (23)**	29.0% (18)	19.4% (12)	4.8% (3)	62
Pre-flashover	17.7% (11)	**46.8% (29)**	17.7% (11)	12.9% (8)	4.8% (3)	62
Flashover	**72.6% (45)**	19.4% (12)	1.6% (1)	3.2% (2)	3.2% (2)	62
					answered question	**62**
					skipped question	**0**

21. Please rate the following statements as they apply to ALL of your virtual environment scenarios.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Response Count
A. While taking part in the scenarios, I felt completely engaged.	0.0% (0)	6.5% (4)	9.7% (6)	**59.7% (37)**	24.2% (15)	62
B. The visual aspects of the environments involved me.	0.0% (0)	1.6% (1)	4.8% (3)	**56.5% (35)**	37.1% (23)	62
C. While in the virtual environment, I was unaware of events occurring in the real world around me.	1.6% (1)	14.5% (9)	9.7% (6)	**46.8% (29)**	27.4% (17)	62
D. I was unaware of my display and control devices.	8.1% (5)	**50.0% (31)**	25.8% (16)	11.3% (7)	4.8% (3)	62
E. I was easily able to recognize objects.	0.0% (0)	0.0% (0)	4.8% (3)	43.5% (27)	**51.6% (32)**	62
F. I could examine objects from multiple viewpoints without difficulty.	0.0% (0)	8.1% (5)	24.2% (15)	**48.4% (30)**	19.4% (12)	62
G. I did not feel confused or disoriented at any point during the experimental sessions.	0.0% (0)	22.6% (14)	14.5% (9)	**45.2% (28)**	17.7% (11)	62
H. I was very involved in the virtual environment experience.	0.0% (0)	4.8% (3)	6.5% (4)	**66.1% (41)**	22.6% (14)	62
I. By the end of the experience, I felt proficient in moving and interacting with the virtual environments.	0.0% (0)	12.9% (8)	22.6% (14)	**45.2% (28)**	19.4% (12)	62
J. I was so involved in the experience that I lost track time.	0.0% (0)	25.8% (16)	29.0% (18)	**32.3% (20)**	12.9% (8)	62
					answered question	**62**
					skipped question	**0**

22. Please rate the following statements based on ONLY the firefighting scenarios.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Response Count
A. The auditory aspects of the environment helped me feel involved.	0.0% (0)	1.6% (1)	6.5% (4)	**72.6% (45)**	19.4% (12)	62
B. I experienced no difficulty identifying sounds.	1.6% (1)	17.7% (11)	6.5% (4)	**54.8% (34)**	19.4% (12)	62
C. I was able to localize sounds.	1.6% (1)	8.1% (5)	22.6% (14)	**54.8% (34)**	12.9% (8)	62
D. The sound helped enhance the experience.	0.0% (0)	0.0% (0)	6.6% (4)	**63.9% (39)**	29.5% (18)	61
E. The radio-simulated sound helped enhance the experience.	0.0% (0)	1.6% (1)	4.8% (3)	**61.3% (38)**	32.3% (20)	62
F. I experienced no difficulty in understanding sounds during the experiment.	1.6% (1)	14.5% (9)	6.5% (4)	**61.3% (38)**	16.1% (10)	62
					answered question	**62**
					skipped question	**0**

23. Please rate the following statements based on ONLY the firefighting scenarios.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Response Count
A. I was visually able to survey and search the environment.	0.0% (0)	8.3% (5)	6.7% (4)	**58.3% (35)**	26.7% (16)	60
B. The visual display quality did not distract me from the environment.	0.0% (0)	6.8% (4)	10.2% (6)	**61.0% (36)**	22.0% (13)	59
C. The control mechanism did not distract me.	1.7% (1)	16.7% (10)	31.7% (19)	**41.7% (25)**	8.3% (5)	60
D. The control devices did not distract me from the environment.	1.7% (1)	16.7% (10)	28.3% (17)	**43.3% (26)**	10.0% (6)	60
E. I was able to concentrate on the environment rather than on the control mechanisms.	0.0% (0)	15.3% (9)	32.2% (19)	**39.0% (23)**	13.6% (8)	59
					answered question	**60**
					skipped question	**2**

24. Please rate the following statements based on ONLY the firefighting scenarios.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Response Count
A. I was able to adjust easily and quickly to working in the virtual reality environment.	0.0% (0)	6.5% (4)	25.8% (16)	**56.5% (35)**	11.3% (7)	62
B. The interactions with the virtual environment seemed natural.	0.0% (0)	16.1% (10)	25.8% (16)	**48.4% (30)**	9.7% (6)	62
C. My movement through the virtual reality environment felt natural.	1.6% (1)	29.5% (18)	**37.7% (23)**	26.2% (16)	4.9% (3)	61
D. Controlling my movement through the virtual reality environment did not distract me from the task at hand.	1.6% (1)	27.9% (17)	**34.4% (21)**	29.5% (18)	6.6% (4)	61
E. My general experiences in the virtual fire environment seemed consistent with my real-world experiences.	0.0% (0)	12.9% (8)	25.8% (16)	**53.2% (33)**	8.1% (5)	62
F. My ability to identify fire condition indicators was consistent with my ability to identify these indications in real-life scenarios.	1.6% (1)	6.5% (4)	22.6% (14)	**62.9% (39)**	6.5% (4)	62
					answered question	**62**
					skipped question	**0**

25. Please rate the following statements based on ONLY the firefighting scenarios.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Response Count
A. Using the decision table did not interfere with the flow of events.	6.6% (4)	**31.1% (19)**	**31.1% (19)**	26.2% (16)	4.9% (3)	61
B. The decision table provided information that I typically obtain to make real life decisions during line of action.	0.0% (0)	4.9% (3)	13.1% (8)	**70.5% (43)**	11.5% (7)	61
					answered question	**61**
					skipped question	**1**

26. Please list any other information which was NOT available in the decision table that you might typically get over the radio.

	Response Count
	18
answered question	**18**
skipped question	**44**

Page 1, Q1. Please enter your assigned participant code for this study.

1	LS056	Jun 21, 2011 3:46 AM
2	HF055	Jun 17, 2011 6:42 AM
3	LS052	Jun 10, 2011 8:52 AM
4	LS054	Jun 10, 2011 8:31 AM
5	HF053	Jun 10, 2011 7:19 AM
6	HF051	Jun 3, 2011 8:02 AM
7	LS050	May 27, 2011 7:33 AM
8	HF049	May 13, 2011 10:13 AM
9	LS048	Apr 29, 2011 8:11 AM
10	HF046	Apr 29, 2011 6:52 AM
11	HF047	Apr 29, 2011 6:08 AM
12	LS045	Apr 22, 2011 9:13 AM
13	LS044	Apr 22, 2011 8:17 AM
14	HF042	Apr 22, 2011 6:49 AM
15	HF043	Apr 22, 2011 6:08 AM
16	LS041	Apr 15, 2011 10:07 AM
17	LS039	Apr 15, 2011 8:42 AM
18	LS040	Apr 15, 2011 7:41 AM
19	LS037	Apr 15, 2011 7:00 AM
20	HF038	Apr 15, 2011 6:21 AM
21	HF036	Apr 8, 2011 9:19 AM
22	HF034	Apr 8, 2011 8:16 AM
23	HF035	Apr 8, 2011 7:58 AM
24	HF032	Apr 8, 2011 7:03 AM
25	HF033	Apr 8, 2011 6:59 AM
26	HF031	Apr 1, 2011 2:47 PM
27	HF029	Apr 1, 2011 12:20 PM

Page 1, Q1. Please enter your assigned participant code for this study.

28	HF030	Apr 1, 2011 11:28 AM
29	HF27	Mar 25, 2011 9:01 AM
30	HF028	Mar 25, 2011 8:15 AM
31	HF025	Mar 25, 2011 7:26 AM
32	HF026	Mar 25, 2011 6:33 AM
33	HF024	Mar 17, 2011 5:42 AM
34	HF023	Mar 11, 2011 10:39 AM
35	HF021	Mar 11, 2011 8:40 AM
36	HF022	Mar 11, 2011 8:21 AM
37	HF020	Mar 11, 2011 8:06 AM
38	LS019	Mar 4, 2011 8:30 AM
39	HF018	Mar 4, 2011 6:58 AM
40	HF017	Feb 25, 2011 10:43 AM
41	HF016	Feb 25, 2011 9:56 AM
42	HF014	Feb 25, 2011 8:08 AM
43	HF015	Feb 25, 2011 7:29 AM
44	LS012	Feb 18, 2011 10:07 AM
45	LS013	Feb 18, 2011 10:04 AM
46	LS010	Feb 18, 2011 8:39 AM
47	LS011	Feb 18, 2011 7:54 AM
48	fg009	Jul 7, 2010 2:59 PM
49	fg008	Jul 7, 2010 2:27 PM
50	fg007	Jul 7, 2010 1:02 PM
51	FG006	Jul 7, 2010 12:27 PM
52	FG005	May 28, 2010 10:08 AM
53	FG004	May 28, 2010 9:45 AM
54	FG003	May 28, 2010 9:16 AM

Page 1, Q1. Please enter your assigned participant code for this study.

55	FG002	May 28, 2010 8:52 AM
56	FG001	May 28, 2010 8:29 AM
57	FG6	May 19, 2010 9:04 AM
58	5	Apr 28, 2010 10:25 AM
59	4	Apr 28, 2010 9:53 AM
60	3	Apr 28, 2010 9:30 AM
61	2	Apr 28, 2010 9:01 AM
62	1	Apr 28, 2010 8:28 AM

Page 7, Q3. Please explain why you selected the option for the previous question.		
1	Mail still in the mailbox indicating no one had picked up the mail.	Jun 21, 2011 3:50 AM
2	I assume always that an involved structure is occupied unless on scene reliable info states the contrary.	Jun 17, 2011 8:22 AM
3	No cars were parked on the street, no other info was given if there were occupants.	Jun 10, 2011 9:48 AM
4	No cars or signs of people	Jun 10, 2011 8:53 AM
5	Car in Drive, Mailbox open	Jun 10, 2011 8:18 AM
6	Vehicles in driveway	Jun 3, 2011 8:05 AM
7	Newspapers stacked by the door. Mailbox full. No cars around. No toys or lawn furniture around house.	May 27, 2011 7:43 AM
8	Vehicle in the garage. Garage Door open.	May 13, 2011 10:31 AM
9	type of residence time of day	Apr 29, 2011 8:19 AM
10	Vehicle in driveway	Apr 29, 2011 7:29 AM
11	Truck in Driveway	Apr 29, 2011 6:55 AM
12	pool drained, newspapers out front, mail box open with uncollected contents.	Apr 22, 2011 9:16 AM
13	Middle of the day, no vehicles or other signs of occupation.	Apr 22, 2011 8:19 AM
14	Car in driveway	Apr 22, 2011 7:24 AM
15	Time of day	Apr 22, 2011 6:52 AM
16	it is a residential structure... i am going to assume there is until told otherwise	Apr 15, 2011 10:12 AM
17	newspapers out front	Apr 15, 2011 9:27 AM
18	newspapers,mail,empty pool	Apr 15, 2011 8:45 AM
19	vehicle in drive way/time of day	Apr 15, 2011 7:32 AM
20	The garage door were down and the newspaper was on the sidewalk.	Apr 15, 2011 7:02 AM
21	vehicle in drive	Apr 8, 2011 8:48 AM
22	Truck in drive	Apr 8, 2011 8:18 AM
23	Daytime incident. Could be a family home, but no visible cars in the driveway.	Apr 8, 2011 7:43 AM
24	vehicle in the driveway	Apr 8, 2011 7:06 AM
25	Because there is not an "I don't know" responce option.	Apr 1, 2011 2:51 PM
26	There was a small Chevy S-10 pickup truck in driveway.	Apr 1, 2011 12:53 PM

Page 7, Q3. Please explain why you selected the option for the previous question.

27	Daytime fire; residential, everyone should be awake & aware	Apr 1, 2011 12:23 PM
28	car in drive, day time	Mar 25, 2011 9:42 AM
29	Truck in driveway Open mailbox	Mar 25, 2011 9:04 AM
30	vehicle in driveway	Mar 25, 2011 8:02 AM
31	Daytime, car in driveway, no people outside	Mar 25, 2011 7:29 AM
32	Time of day, truck in driveway, and reported by passer by.	Mar 17, 2011 5:44 AM
33	Car in the driveway. I should have listened to all the information and walked around the house.	Mar 11, 2011 10:42 AM
34	car in driveway	Mar 11, 2011 9:25 AM
35	Day time in a residential neighborhood	Mar 11, 2011 8:43 AM
36	Truck in driveway	Mar 11, 2011 8:09 AM
37	Mail and news paper build up but still must assume that people are inside until you determine that no one is by searching the home.	Mar 4, 2011 8:40 AM
38	It was reported from a firefighter that people were inside and if we could ventilate it would assist them.	Mar 4, 2011 8:01 AM
39	Addditonal resources are delayed for vertical ventilation. The goal is to make the interior tennable for the possible occupants in a timely manner.	Feb 25, 2011 10:47 AM
40	Truck in the driveway	Feb 25, 2011 10:02 AM
41	Vehicle in the driveway.	Feb 25, 2011 8:49 AM
42	There was a truck un the driveway.	Feb 25, 2011 8:13 AM
43	shoes at the front door	Feb 18, 2011 10:48 AM
44	thought i saw shoes near the front entrance	Feb 18, 2011 10:10 AM
45	Due to time of day, no cars in driveway, mail/newspaper has not been received for awhile	Feb 18, 2011 9:19 AM
46	accumulation of mail and newspapers in the mailbox and on the front step.	Feb 18, 2011 8:42 AM
47	Did not hear info that told me otherwise.	Jul 7, 2010 3:06 PM
48	Build Up of Newpapers and Mail In The Mailbox	Jul 7, 2010 1:06 PM
49	Newspaper was sitting outside the front door and had not been picked up.	Jul 7, 2010 12:35 PM
50	there was high smoke coming form every window and eve so they were unlikely not in there unless they were unresponsive	May 28, 2010 10:15 AM

Page 7, Q3. Please explain why you selected the option for the previous question.		
51	there was a stack of news papers on the front porch there was mail in the mail box there was no cars in the garage and there was not any water in the pool that I could tell...	May 28, 2010 9:56 AM
52	It was stated there were no occupants	May 28, 2010 9:23 AM
53	I did not get information indicating that there were or were not in the house so I go with there being occupants until confirmed.	May 28, 2010 8:39 AM
54	time of day	May 19, 2010 9:08 AM
55	Car in front of house	Apr 28, 2010 10:32 AM
56	Daytime hours- most people can self evac. during the daytime.	Apr 28, 2010 10:00 AM
57	People weren't home, they garage doors weren't open so it lead me to believe it was during the day.	Apr 28, 2010 9:42 AM
58	time of day - I though I heard that the door was locked	Apr 28, 2010 9:10 AM
59	Day time - they should have self escaped. No toys or activity outside of the home. I would have prioritized fire control over primary search without a known or likely rescue.	Apr 28, 2010 8:46 AM

Page 15, Q2. Please list any other information which was NOT available in the decision table that you might typically get over the radio.		
1	None.	Jun 10, 2011 9:52 AM
2	Water supply location, initial report by a police officer or information from other 911 calls that may have been placed by passerbys, neighbors, etc.	Jun 3, 2011 8:13 AM
3	More dispatch information about who called 911 (owners vs. neighbor, etc.)	May 13, 2011 10:36 AM
4	Crews on hand that we can deploy.	Apr 29, 2011 7:00 AM
5	A HUD of the functions of the controler	Apr 22, 2011 7:29 AM
6	reports from neighbors or bystanders or witnesses.	Apr 15, 2011 8:54 AM
7	In the first scenario, I was unable to move and perform a 360 walk around.	Apr 1, 2011 2:58 PM
8	Other units/resources that are enroute to the scene.	Apr 1, 2011 12:59 PM
9	occupant status	Mar 25, 2011 7:34 AM
10	Some of that information we get enroute and know before we arrive. It was hard to get that information while on scene and trying to get the size up done.	Mar 11, 2011 10:51 AM
11	The decision table seemed to work differrently in the fire scenarios.	Mar 11, 2011 8:48 AM
12	In the first fire scenario from the exterior I could not hear half of the choices and DC Bayouths voice. It was adjusted for the interior scenario. I would have liked being able to hear the information better for the exterior of the building.	Mar 11, 2011 8:16 AM
13	Is an officer on scene?	Mar 4, 2011 8:47 AM
14	None.	Feb 25, 2011 10:57 AM
15	Time of day	Feb 25, 2011 8:58 AM
16	I think I needed more time getting use to the movement part of the simulator to get a good opinion.	May 28, 2010 9:03 AM
17	the ability to request additonal resources	Apr 28, 2010 9:08 AM
18	1. Reports by occupants or neighbors of occupants and possible seat of fire. This wouldn't be on radio, but face-to-face interaction upon arrival. 2. Wind speed and direction for concern with wind-driven fires. 3. I may have missed this, but units starting their response and arriving.	Apr 28, 2010 8:43 AM

Appendix I – Physiological Results

Pre-Backdraft Scene

Participant	HR-min	HR-max	HR-mean	stddev	HR-Base_line	HR-Norm (Min-Base)	HR-Norm (Max-Base)	stddev	BP-min	BP-max	PB-mean	stddev	BP-Base_line	BP-Norm (Min-Base)	BP-Norm (Max-Base)
FG001	67.3	91.8	80.5	4.3	75.5	-10.9	21.6	10.6	316.0	348.0	329.1	9.8	114.0	177.2	205.3
FG002	74.7	199.2	96.2	14.9	82.1	-9.1	142.6	4.6	145.1	175.0	159.6	9.3	122.0	19.0	43.4
FG003	61.6	83.9	68.0	5.5	63.3	-2.6	32.6	10.2	159.9	170.0	164.2	3.9	118.0	35.5	44.1
FG004	84.4	111.4	97.2	6.9	88.6	-4.7	25.7	3.6	154.0	188.0	169.0	8.5	165.0	-6.7	13.9
FG005	58.2	84.5	70.3	5.6	61.8	-5.9	36.7	5.0	150.6	172.0	163.9	5.6	108.0	39.4	59.3
FG006	57.5	183.1	111.0	16.1	85.0	-32.4	115.4	2.6	179.4	200.0	188.8	6.3	138.0	30.0	44.9
FG007	85.5	159.8	107.4	8.5	107.3	-20.3	48.9	3.8	172.0	211.0	193.9	10.1	133.0	29.3	58.6
FG008	70.8	84.9	75.1	3.0	74.5	-5.0	13.9	1.7	176.5	182.0	180.0	4.5	118.0	49.6	54.2
FG009	67.7	97.7	83.2	6.8	71.6	-5.4	36.4	7.8	176.0	202.0	188.2	8.2	138.0	27.5	46.4
FG1	66.5	147.5	76.1	6.0	70.5	-5.7	109.2	9.3	178.0	219.0	198.5	8.8	135.0	31.9	62.2
FG2	79.1	98.6	87.9	4.1	83.8	-5.6	17.7	2.7	166.1	179.0	173.0	3.2	132.0	25.8	35.6
FG3	71.0	102.3	90.7	6.3	86.7	-18.1	18.0	7.4	164.5	206.5	181.1	12.4	142.0	15.8	45.4
FG4	70.7	94.7	83.7	2.9	75.9	-6.8	24.8	3.9	137.5	148.5	141.2	2.8	121.0	13.6	22.7
FG5	47.6	168.6	93.0	6.7	87.4	-45.5	92.9	9.5	210.5	237.5	220.4	7.1	130.0	61.9	82.7
HF014	63.3	120.4	74.7	5.9	75.4	-16.1	59.6	1.5	201.8	222.0	211.0	6.0	145.0	39.2	53.1
HF015	59.9	82.7	73.1	4.3	71.7	-16.4	15.3	11.4	152.5	152.5	152.5	2.0	123.0	24.0	24.0
HF016	85.0	105.7	97.8	10.1	89.3	-4.8	18.3	1.9	138.0	233.0	198.3	24.1	136.0	1.5	71.3
HF017	80.4	110.0	96.3	5.7	92.7	-13.2	18.7	8.2	125.5	211.5	173.1	21.7	143.0	-12.2	47.9
HF018	42.0	92.5	78.7	7.8	69.6	-39.7	32.9	12.7	133.5	166.5	153.5	9.8	116.0	15.1	43.5
HF020	59.6	122.0	95.8	11.0	95.1	-37.4	28.3	0.7	167.5	213.5	197.6	11.9	124.0	35.1	72.2
HF021	70.4	107.6	88.7	6.3	89.2	-21.1	20.6	4.8	158.5	175.5	164.2	4.8	128.0	23.8	37.1
HF022	80.3	108.2	95.1	3.7	80.4	-0.2	34.5	4.8	143.0	181.6	166.0	13.1	116.0	23.3	56.6
HF023	77.6	103.0	91.2	6.0	82.8	-6.3	24.4	10.7	153.2	160.0	156.7	3.5	115.0	33.2	39.1
HF024	36.5	96.5	79.4	11.8	73.2	-50.2	31.8	3.1	112.9	180.0	164.3	16.1	115.0	-1.8	56.5
HF025	70.5	104.6	90.6	7.4	75.6	-6.7	38.3	8.6	205.1	241.5	224.2	10.6	142.0	44.4	70.1
HF026	77.9	114.0	91.0	7.3	75.7	2.9	50.6	1.9	219.0	247.2	232.2	7.0	161.0	36.0	53.6
HF027	88.3	106.1	101.3	8.0	119.0	-25.8	-10.8	1.8	112.5	182.3	141.4	22.0	147.0	-23.5	24.0
HF028	61.9	118.3	77.5	6.0	79.4	-22.0	49.0	4.2	159.5	190.5	174.3	12.4	130.0	22.7	46.5
HF029	86.7	103.7	96.2	3.6	79.7	8.7	30.1	3.5	225.6	243.0	233.4	6.1	147.0	53.4	65.3
HF030	64.8	182.6	82.5	13.3	84.8	-23.6	115.3	4.0	168.6	197.5	184.2	7.2	137.0	23.1	44.2
HF031	75.2	106.9	85.7	10.0	79.7	-5.7	34.2	2.5	140.5	175.0	163.6	10.6	120.0	17.1	45.8
HF032	92.1	102.1	96.5	2.8	90.4	1.9	12.9	8.0	104.0	172.0	133.2	22.9	147.0	-29.3	17.0
HF033	72.1	92.1	81.6	4.5	75.3	-4.3	22.3	3.8	125.0	165.0	146.9	9.9	133.0	-6.0	24.1
HF034	67.6	177.6	93.6	12.6	87.4	-22.6	103.2	5.6	125.0	180.0	153.2	19.7	130.0	-3.8	38.5
HF035	70.6	109.5	88.4	6.8	80.1	-11.9	36.7	1.8	192.2	206.0	199.1	3.7	138.0	39.3	49.3
HF036	62.1	88.8	69.9	5.5	66.6	-6.7	33.3	1.7	172.0	195.0	185.1	7.7	142.0	21.1	37.3
HF038	46.5	186.7	97.8	17.0	73.7	-37.0	153.4	0.2	67.5	157.7	136.7	22.1	116.0	-41.8	35.9
HF042	67.4	163.2	77.0	9.3	72.6	-7.2	124.8	6.7	197.0	252.0	214.9	17.0	132.0	49.2	90.9
HF043	35.7	199.5	92.5	38.9	82.5	-56.7	141.8	0.4	98.5	154.5	133.8	15.9	121.0	-18.6	27.7
HF046	82.6	106.3	94.3	5.1	82.2	0.5	29.3	7.2	144.0	210.0	182.6	12.7	121.0	19.0	73.6

HF047	64.1	144.2	95.0	11.8	94.0	-31.8	53.4	1.4		197.0	247.0	226.2	14.6	117.0	68.4	111.1
HF049	69.0	136.8	90.9	12.4	73.7	-6.4	85.7	7.3		170.6	171.3	170.9	1.5	129.0	32.2	32.8
HF051	46.1	154.4	90.9	7.5	71.9	-35.9	114.7	12.0		168.9	185.0	178.6	6.4	129.0	30.9	43.4
HF053	74.5	92.5	83.7	3.4	69.5	7.2	33.0	8.7		170.5	186.5	180.8	5.3	112.0	52.2	66.5
HF055	71.7	183.4	108.8	21.4	78.3	-8.4	134.2	0.6		208.5	237.5	216.4	9.2	130.0	60.4	82.7
LS010	65.6	101.9	83.2	9.0	82.4	-20.4	23.7	11.6		128.5	184.5	149.3	11.1	135.0	-4.8	36.7
LS011	73.0	111.2	94.6	7.5	78.8	-7.4	41.2	2.8		144.0	190.0	171.6	10.5	128.0	12.5	48.4
LS012	86.3	178.6	117.4	12.4	78.7	9.6	126.8	2.9		181.9	204.0	191.6	5.4	127.0	43.2	60.6
LS013	31.3	181.8	86.9	18.8	78.7	-60.2	130.9	2.4		94.8	253.5	175.3	26.1	134.0	-29.3	89.2
LS019	76.8	164.7	113.5	9.5	78.7	-2.3	109.3	4.8		145.5	243.1	186.6	35.0	132.0	10.2	84.2
LS037	31.0	194.4	92.3	33.7	78.7	-60.6	147.1	0.2		168.5	184.5	178.1	4.3	157.0	7.3	17.5
LS039	57.1	111.9	75.7	7.5	78.6	-27.4	42.3	6.7		129.0	151.0	136.0	4.1	124.0	4.0	21.8
LS040	70.5	95.9	81.8	4.6	78.6	-10.4	22.0	25.1		131.0	185.0	163.5	12.3	128.0	2.3	44.5
LS041	57.6	195.7	86.1	15.8	78.6	-26.7	148.9	1.3		161.5	161.5	161.5	2.2	130.0	24.2	24.2
LS044	30.3	195.0	96.8	60.4	78.6	-61.4	148.2	2.9		174.7	193.5	185.9	5.9	123.0	42.0	57.3
LS045	76.8	104.8	92.8	5.5	78.6	-2.2	33.5	6.9		162.5	183.5	172.9	4.8	125.0	30.0	46.8
LS048	76.9	93.7	85.1	3.7	78.5	-2.0	19.3	9.2		163.5	189.5	177.9	6.7	117.0	39.7	62.0
LS050	71.3	154.8	94.5	6.6	78.5	-9.2	97.1	37.9		133.0	176.7	151.0	10.4	128.0	3.9	38.0
LS052	37.2	95.0	79.7	10.4	78.5	-52.6	21.0	8.4		166.0	166.0	166.0	2.4	130.0	27.7	27.7
LS054	45.5	193.8	94.4	26.1	78.5	-42.0	147.0	1.2		204.9	216.5	211.8	4.6	135.0	51.8	60.4
LS056	59.8	76.0	68.5	3.2	78.4	-23.8	-3.1	10.9		188.5	221.5	204.0	11.0	110.0	71.4	101.4

Pre-Backdraft Scene

Participant	HR-min	HR-max	HR-mean	stddev	HR-Base	HR-Norm(min-base)	HR-Norm(max-base)		BP-min	BP-max	BP-mean	stddev	BP-Base	BP-Norm(Min-base)	BP-Norm(Max-base)
FG001	73.2	90.5	81.4	3.7	75.5	-3.1	19.8		296.0	332.0	314.7	10.0	114.0	159.6	191.2
FG002	72.4	183.7	103.5	21.8	82.1	-11.8	123.7		134.8	153.0	146.1	5.4	122.0	10.5	25.4
FG003	62.5	144.1	70.7	10.5	63.3	-1.3	127.6		117.3	164.0	149.6	16.7	118.0	-0.6	39.0
FG004	85.4	103.6	93.5	5.2	88.6	-3.6	16.9		151.0	184.0	164.9	11.6	165.0	-8.5	11.5
FG005	64.0	82.7	71.9	4.1	61.8	3.6	33.8		152.0	165.0	156.1	5.1	108.0	40.8	52.8
FG006	79.1	180.2	117.6	26.9	85.0	-7.0	112.0		177.0	188.3	180.8	6.6	138.0	28.3	36.4
FG007	79.7	174.1	109.6	13.0	107.3	-25.7	62.2		181.0	199.0	188.2	5.9	133.0	36.1	49.6
FG008	70.5	87.3	76.1	4.3	74.5	-5.3	17.1		181.6	189.0	186.3	4.3	118.0	53.9	60.2
FG009	67.0	93.4	81.2	5.3	71.6	-6.5	30.5		179.9	180.0	179.8	5.2	138.0	30.3	30.4
FG1	59.2	130.3	81.7	9.0	70.5	-16.0	84.8		192.0	201.0	196.4	4.5	135.0	42.2	48.9
FG2	79.9	119.5	106.8	6.7	83.8	-4.6	42.6		164.0	197.9	180.4	10.7	132.0	24.2	49.9
FG3	77.1	96.2	87.9	3.8	86.7	-11.0	11.0		173.8	195.5	188.4	7.0	142.0	22.4	37.7
FG4	82.7	89.6	86.4	2.9	75.9	8.9	18.1		148.5	149.0	148.5	4.0	121.0	22.7	23.1
FG5	67.8	190.8	101.2	15.7	87.4	-22.5	118.3		222.5	245.8	234.1	10.5	130.0	71.2	89.1
HF014	66.9	80.5	74.3	3.1	75.4	-11.3	6.8		199.0	204.0	201.5	4.5	145.0	37.2	40.7
HF015	56.5	119.3	72.8	9.0	71.7	-21.2	66.4		152.5	152.5	152.4	4.3	123.0	24.0	24.0
HF016	44.2	44.2	44.2	1.3	89.3	-50.4	-50.4		213.0	213.0	212.8	6.1	136.0	56.6	56.6
HF017	84.6	107.4	99.0	6.9	92.7	-8.7	15.9		161.5	161.5	161.4	4.7	143.0	12.9	12.9
HF018	67.9	79.8	73.8	3.0	69.6	-2.4	14.6		149.5	149.5	149.4	3.5	116.0	28.9	28.9
HF020	65.2	118.0	90.9	12.5	95.1	-31.4	24.1		204.5	212.1	207.3	5.7	124.0	64.9	71.1

HF021	69.3	101.6	89.4	10.9	89.2	-22.3	13.8		167.9	170.5	169.0	7.1	128.0	31.1	33.2
HF022	88.6	101.7	95.3	4.0	80.4	10.2	26.5		129.0	163.0	145.3	13.4	116.0	11.2	40.5
HF023	50.7	108.9	99.4	8.7	82.8	-38.8	31.6		127.0	151.2	140.0	8.7	115.0	10.4	31.5
HF024	38.3	90.9	71.4	15.7	73.2	-47.6	24.2		128.0	161.0	146.1	9.7	115.0	11.3	40.0
HF025	76.0	107.3	88.5	8.6	75.6	0.5	42.0		222.9	234.5	230.4	4.5	142.0	57.0	65.1
HF026	81.5	112.3	95.0	5.9	75.7	7.6	48.4		183.0	241.0	219.4	18.6	161.0	13.7	49.7
HF027	134.7	134.7	134.6	3.6	119.0	13.2	13.2		158.5	158.5	158.4	4.3	147.0	7.8	7.8
HF028	40.9	125.1	81.0	8.5	79.4	-48.5	57.6		159.5	159.5	159.5	2.4	130.0	22.7	22.7
HF029	91.4	107.3	98.8	5.0	79.7	14.6	34.7		201.4	216.0	210.0	7.8	147.0	37.0	46.9
HF030	68.0	173.1	81.9	16.1	84.8	-19.9	104.1		120.8	175.5	148.4	16.9	137.0	-11.8	28.1
HF031	70.7	95.6	85.4	7.6	79.7	-11.3	20.0		154.4	185.0	172.5	11.5	120.0	28.6	54.2
HF032	89.1	101.7	96.2	3.3	90.4	-1.4	12.5		164.0	164.0	163.9	3.1	147.0	11.6	11.6
HF033	77.8	148.0	97.7	8.0	75.3	3.3	96.6		150.0	172.5	157.3	6.8	133.0	12.8	29.7
HF034	65.4	199.2	95.1	23.2	87.4	-25.2	127.9		165.0	165.0	164.9	3.6	130.0	26.9	26.9
HF035	73.7	102.4	89.1	7.3	80.1	-8.0	27.8		139.9	203.0	176.0	20.8	138.0	1.3	47.1
HF036	62.8	95.3	74.7	8.2	66.6	-5.7	43.1		172.0	178.0	175.1	3.8	142.0	21.1	25.4
HF038	86.9	97.8	91.6	5.3	73.7	17.9	32.7		118.5	139.3	127.4	7.8	116.0	2.2	20.0
HF042	39.5	97.4	74.2	8.9	72.6	-45.6	34.1		152.0	152.0	151.8	4.8	132.0	15.2	15.2
HF043	64.6	192.9	111.4	38.7	82.5	-21.7	133.8		137.4	143.5	141.0	4.9	121.0	13.5	18.6
HF046	85.3	100.1	93.5	5.5	82.2	3.7	21.8		134.4	184.0	167.6	17.9	121.0	11.1	52.1
HF047	66.7	132.6	93.0	10.6	94.0	-29.0	41.0		196.4	225.0	216.2	11.0	117.0	67.9	92.3
HF049	64.9	135.5	92.9	13.8	73.7	-11.9	83.8		137.0	176.0	159.4	12.8	129.0	6.2	36.4
HF051	80.1	96.2	88.8	4.2	71.9	11.4	33.8		166.3	170.0	169.3	3.9	129.0	28.9	31.8
HF053	78.2	88.4	83.2	3.9	69.5	12.5	27.2		179.5	186.7	181.8	6.4	112.0	60.3	66.7
HF055	67.4	196.9	104.5	22.3	78.3	-13.9	151.5		186.5	206.5	195.6	8.8	130.0	43.5	58.8
LS010	72.5	98.7	88.3	5.8	82.4	-12.1	19.8		126.5	169.5	150.7	12.0	135.0	-6.3	25.6
LS011	76.3	112.0	99.7	7.2	97.7	-21.9	14.7		134.3	194.0	172.8	14.7	128.0	4.9	51.6
LS012	85.1	165.8	114.1	12.6	96.6	-11.9	71.7		183.7	196.0	189.4	3.8	127.0	44.7	54.3
LS013	31.8	137.5	78.9	15.1	92.5	-65.6	48.6		120.5	137.5	128.6	5.7	134.0	-10.1	2.6
LS019	95.6	112.4	105.4	5.5	82.5	15.9	36.3		218.5	218.5	218.3	6.9	132.0	65.5	65.5
LS037	39.6	196.6	84.0	25.0	68.4	-42.1	187.4		166.5	182.5	174.1	6.0	157.0	6.1	16.2
LS039	58.7	199.2	84.0	14.7	60.0	-2.2	231.9		121.0	163.0	138.1	9.4	124.0	-2.4	31.5
LS040	65.0	84.3	76.8	4.5	75.8	-14.3	11.3		179.0	182.3	179.2	4.4	128.0	39.8	42.4
LS041	74.2	185.3	85.5	23.3	75.2	-1.3	146.5		161.5	161.5	161.3	5.3	130.0	24.2	24.2
LS044	35.2	197.2	64.9	33.2	70.9	-50.4	178.2		25.5	25.5	25.5	0.8	123.0	-79.3	-79.3
LS045	80.9	98.9	88.7	4.8	80.7	0.3	22.5		163.3	174.5	169.4	4.8	125.0	30.7	39.6
LS048	44.1	106.3	86.2	6.5	80.4	-45.1	32.2		119.9	185.5	159.9	22.2	117.0	2.5	58.5
LS050	72.7	161.3	94.9	7.1	82.1	-11.4	96.4		138.0	138.0	138.0	2.2	128.0	7.8	7.8
LS052	41.0	97.8	81.1	10.3	76.5	-46.4	27.9		166.0	166.0	166.0	2.4	130.0	27.7	27.7
LS054	68.3	192.3	79.8	15.1	76.0	-10.1	153.0		202.5	215.0	207.8	6.5	135.0	50.0	59.3
LS056	57.3	70.4	63.9	2.9	67.3	-14.8	4.6		181.5	206.5	191.2	8.3	110.0	65.0	87.7